Gas Journal

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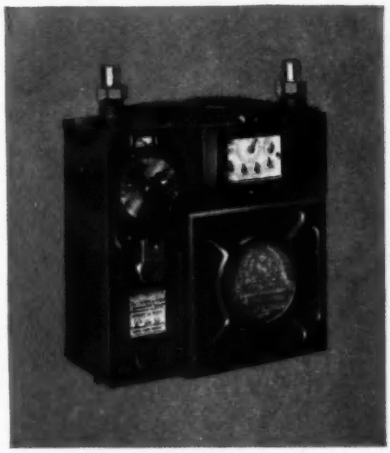

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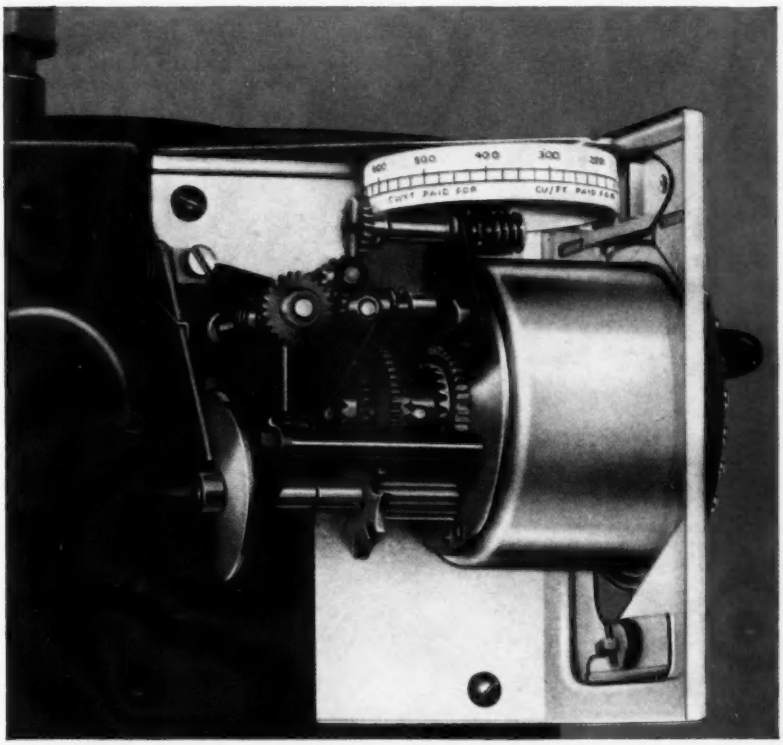

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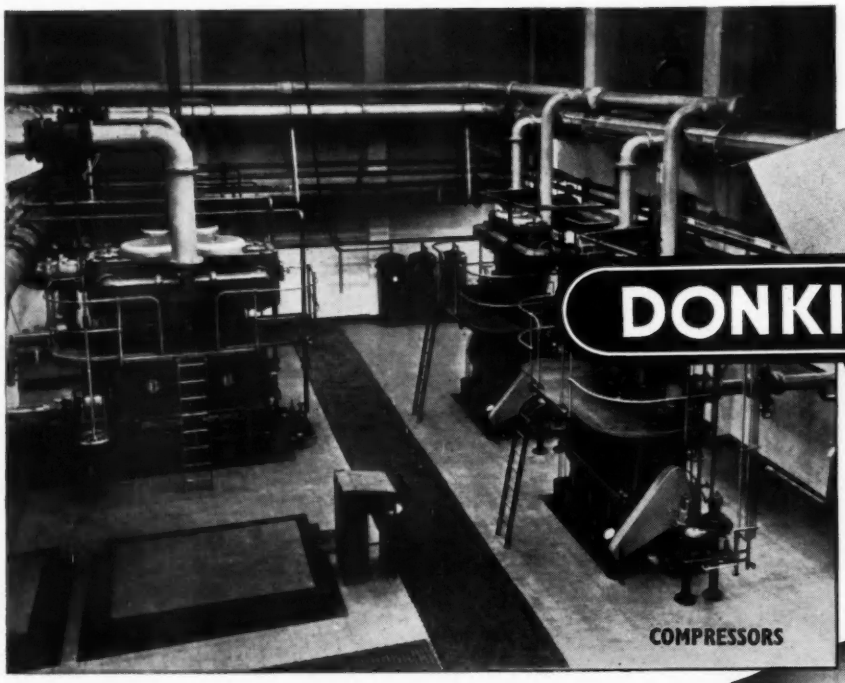

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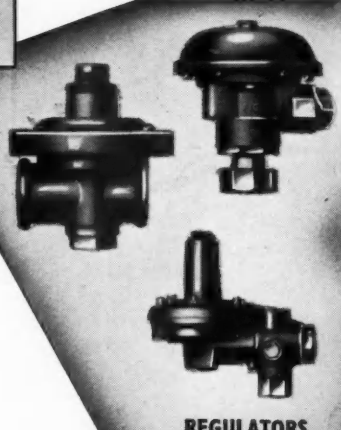

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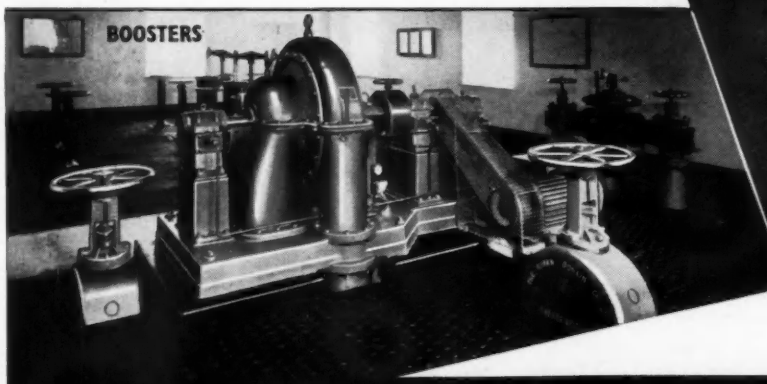

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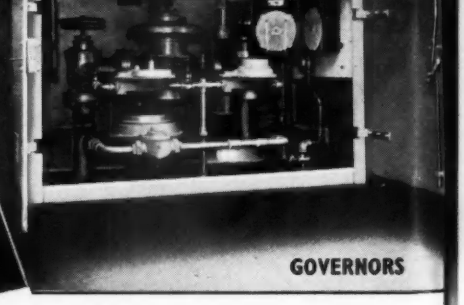

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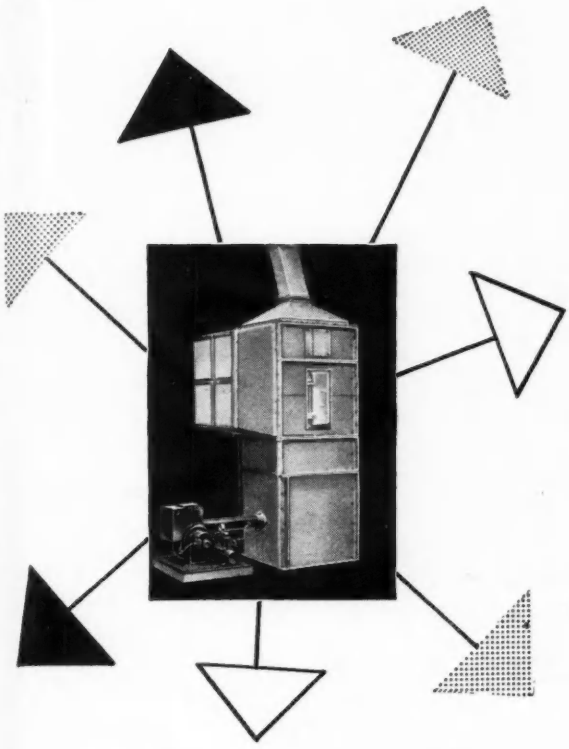

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Gas Journal

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110TH YEAR

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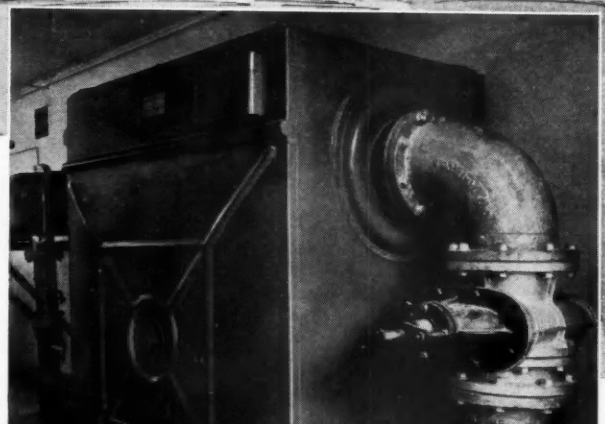

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Gas Journal

VOLUME 295. No. 4961 AUGUST 13, 1958. 110th YEAR

Growing Importance of Provan

EXTENSIONS to the Provan gasworks inaugurated by the Lord Provost of Glasgow this week have increased its gas-making capacity by about 15 mill. cu.ft. per day. The consumption of gas in the industrial area round Glasgow represents proportionally the largest gas demand in the central industrial belt of the Scottish Gas Board's area of supply. So great is it in fact that about 70% of all gas made and consumed in Scotland is supplied to this area. The policy of the Scottish Gas Board is to concentrate all gas-making in as few, large and economic plants as possible and at the same time to make full use of all available gas from other sources. The steel industry in the Glasgow area has surplus coke oven gas for sale and there is also methane drained from neighbouring collieries in the locality which the Board can use.

So important has coke oven gas become that a special purification plant for its treatment was installed at Hollandhurst near Gartsherrie before nationalisation. The new plant at Provan, as well as increasing the production capacity of the works, will be able to distribute larger quantities of coke oven gas as these become available from the new plants being built by the Scottish steel companies in the Glasgow area. Eventually, too, methane will be treated at Provan and distributed through the existing network.

The Provan site, of 123 acres, was originally purchased by the Glasgow Corporation in 1899 and a horizontal retort plant of 12 mill. cu.ft. per day was constructed by 1904. The first additional plant to be installed was of Woodall-Duckham continuous verticals, completed in 1922. This was, and still is, the biggest plant of its kind under one roof in the world, with a capacity of 16.272 mill. cu.ft. per day. During the war carburetted water gas plants were added; but apart from those, the present additions of 7.04 cu.ft. per day of coal gas and 8 mill. cu.ft. per day of c.w.g. are the only major additions since 1922.

The whole of the Glasgow area is being supplied by three manufacturing stations—Provan, Tradeston and Dawsholm—of which Provan is by far the largest. With all three operating and full use being made of the available supplies of coke oven gas, nearly 60 mill. cu.ft. of gas can at present be made available to the Glasgow distribution system.

The new plant which we describe at some length in this issue consists of a Woodall-Duckham continuous vertical retort installation with a capacity of some 7 mill. cu.ft. per day and two Humphreys & Glasgow carburetted water gas units each of 4 mill. cu.ft. per day capacity. The carbonising plant, which has been built on the site of the old horizontal plant, is equipped with up-to-date mechanical handling of coal and coke, together with waste heat recovery.

The layout of this plant is, we think, most interesting in that as far as possible the movement of coal from the railway wagons to the retort house and of the coke to the wagons for despatch is in one direction, the units concerned being sited in a straight line. The greatest possible use has been made of existing ancillary plant and the minimum of additional units have been installed. These consist of additional condenser and purifier capacity, the latter of only 6 mill. cu.ft. per day, to bring the total to 18 mill. cu.ft. per day. Extra boosting plant is also included.

Producer gas for heating the retort settings is provided by mechanical producers fitted with Cyclone dust separators. An augmentation flue can supply additional producer gas to the waste heat boilers for meeting extra steam demands. The fullest use is, therefore, being made of up-to-date equipment in the new works. Added to this, the new carburetted water gas plant has

been equipped with special carburettors to allow the use of heavy oil, should the relative prices of gas oil and heavy oil make this economically desirable.

The ultimate aim of the Scottish Board is a complete integration of the Glasgow and Western Division, which includes a number of small undertakings to the south. These can be supplied by linking them to each other and connecting to a larger manufacturing station with surplus gas-making capacity. In the north of the area, in which the heavy consumption of gas is to be found, all available gas will be utilised with, possibly, in addition, Lurgi gas from the plant being built in Fife, by a connection through Falkirk in the Edinburgh and South Eastern Division. This however is unlikely to happen for a number of years.

In the meantime the plant at Provan, augmented by increasing supplies of coke oven gas and methane from coal mines, will meet the increasing demands made on it. Liquefied methane imported from abroad may at some time in the future be brought up the Clyde, reformed at Dumbarton and be fed into Dawsholm and Provan to meet increasing demands should they occur.

Threat of Labour Trouble

IT is sincerely to be hoped that a satisfactory solution will be found to the pay dispute now existing in the gas industry. Hints of serious trouble, including possible strike action, emerged last Friday when representatives of the National Union of General and Municipal Workers and of the Transport and General Workers' Union met to consider the Gas Council offer of an additional 1½d. an hour in reply to their claim for a substantial wage increase.

The unions' claim is based on the increase in living costs since their last wage award, in March, 1957; loss of parity hitherto enjoyed with workers in electricity and water undertakings and local authorities; and the feeling that workers should share in the increased productivity the industry expects to enjoy as a result of new techniques in gas-making. They point out that since nationalisation they have co-operated to the utmost in the drive for increased efficiency even though this has involved the closure of some 400 works and the displacement of some 6,000 workers resulting, in many cases, in loss of pay. On this point there is much bitterness at the employer's refusal to vary the 1½d. increase offered.

On their side the employers are appreciative of the co-operation they have received and hope earnestly that it may continue. But they point out that the benefits of increased productivity will not be fully felt for at least ten years and will not support a substantial wage increase now. And while they agree that workers in the gas industry have in the past had parity with those in electricity and water undertakings and local authorities, they do not feel tied to maintain this regardless of circumstances: It may well be that during recent years the gas industry has not been making sufficient headway for this parity to be maintained. On the increased cost of living, the employers agree—hence their offer of a 1½d. increase. Their unwillingness to go further is due to the conviction that such a step would be disastrous. Apart from being contrary to the interests of the national economy, it would result either in a deficit throughout the industry or in increased tariffs which would effectively price gas out of the fuel market and lead to the collapse of the industry—at a time when it is at the threshold of a new era.

The attitudes adopted by both sides are thus seen to be founded on sincere and deep convictions, and next week's meetings of the unions—until when it is unlikely that the employers will make any further statement—will be most anxiously awaited. The unions, which are in an unusually bitter mood, will, unless they request a further meeting of the National Joint Industrial Council for the Gas Industry, then have three courses open to them: To accept the offer, if only provisionally; to seek arbitration, now viewed with suspicion by labour generally; or to call for strike action—and though the Conspiracy and Protection of Property Act of 1875 makes it illegal for a gas worker to break his contract, a strike could be imposed by the mass handing in of a week's notice of termination of employment.

Whatever the outcome, the blow that has already fallen on the exceedingly cordial labour relations which the industry has for so long enjoyed is a matter of deep regret.

Industrial Fuel Efficiency

A REMARKABLE example of the way in which stepping up fuel efficiency can affect production costs was given in the *Financial Times* last Friday. The story concerned a second factory on a trading estate in the north-east which had been opened three years previously by a leading U.K. electrical concern. Apparently the management had been disturbed by the amount of gas that the factory consumed and had been scouting for possible methods of economy. Gas in the area was relatively cheap; nevertheless at 10% of overhead charges and 2-3% of total costs it could not be ignored. It was realised that losses in terms of flue gases were heavy and it was known that the apparatus for regulating gas and air was inefficient, but it was not until the National Industrial Fuel Efficiency Service came on the scene that the problem was tackled.

The results of the enterprise may be broadly summarised as follows: At a cost of about £800 the annual fuel bill at the factory has been reduced by rather more than £14,000, or about 20%. It is estimated that an additional saving of over £8,000 per annum would be

possible if various supplementary recommendations of the Fuel Efficency Service were implemented. The capital cost of this latter saving would almost certainly be less than £1,000.

The savings so far achieved have, by contrast, been made at virtually no capital cost at all. The £800 odd expenditure is made up almost exclusively of fees paid to the N.I.F.E.S.—£50 a week for between three and four months. Out of a total of £14,105 a year saved, £12,725—or over 90% is represented by, for example, adjustments to damper settings and altering burner jet sizes, and more generally by improving (where this was possible without capital outlay) insulation. Of the remainder nearly £1,100 was saved by eliminating various unnecessary electric fans, and a final economy of some £200 was made in the boiler house.

The further £8,000 possible savings estimated by the investigators would be derived from a number of specialised economies, including painting the outsides of the television tube 'cooking' ovens fairly extensively with aluminium paint and improving the insulation at the beginning and end of the pipeline (at the points where the tubes entered the ovens and at the points at which they emerged).

Lastly, even given optimum burner and damper adjustment it was estimated that a substantial quantity of heat (3.3 therms an hour in the case of one of the production lines) was being wasted in the form of hot flue gases. The construction of waste heat boilers was therefore suggested. It was calculated that one of these alone would save about £725 a year. But at least one other could also be fitted if that much more hot water could profitably be used.

The article begins by relating a visit from the gas board to see whether the drop in gas consumption had been due to a trade recession! Although on the face of it this may appear slightly comic two points may be made. First, it must ultimately be to the gas industry's benefit to have such a body as N.I.F.E.S. ensure that the customer gets better value for money, although this may involve a reduced sale of gas; secondly, how much better had the gas board suggested some of these economies on their client's behalf.

The Divining Twig

THIS, as people are constantly pointing out, is the age of the scientist and of scientific revelation. Progress in research is relentlessly exposing the remaining pockets of mystery to the cold eye of the trained investigator. Which is no doubt a very good thing for all concerned, and yet speaking personally, we cannot help clinging to the belief that a hint of mystery tends to lend a little spice to life. On those rare occasions when we come across evidence of man's continuing communion with the unknown we find the sensation oddly stimulating. Take the gas main in Lode Lane, Solihull, a story for which we are indebted to the *Birmingham Post* . . .

It seems that this main, which has been buried beneath part of the old Lode Lane, Solihull, for nearly 20 years, has been 'found' with two pieces of bent wire and a hazel twig. Although they had plans of the pipe's location workmen on the job have found it difficult to assess the lie of the main. The foreman in charge used two pieces of wire to 'divine' the pipe and the accuracy of his divining was reinforced when Mr. Leonard Allen, District Mains Superintendent for the West Midlands Gas Board, arrived with a gnarled hazel twig which he has used for eight years for finding buried pipes.

We have heard of such cases before and it is nice to know that the hazel twig is still twitching in the interests of the gas industry. What disturbs us, however, is the thought that if in this day and age, the hazel twig is still the best way of tracing a long-buried main, equally old established methods may still be superior for other types of work. For example, imagine the chief accountant who, needing a complicated figure at short notice, turns his back on his electronic computers and scratches about in a handful of sand on his office floor. Rising hastily to his feet and dusting his knees, he telephones the answer through to his chairman, 'Astonishing!' exclaims the latter, 'Worth every penny of the £90,000 we spent on the new machinery.' Or think of the production engineer faced with the possibility of a cold snap who, ignoring the exhaustively prepared weather forecasts, stealthily goes to his office safe and has a look at his seaweed. There is no telling how much of this sort of thing goes on. Nobody has yet suggested that the gas holder fire at Portsmouth the other week was the result of witchcraft but you never know, do you? Coming back to the hazel twig, we wonder if Mr. Allen could be interested in the search for natural gas . . .

Personal

MR. ERNEST WEST, Managing Director of West's Gas Improvement Company, has celebrated his 80th birthday. To mark the occasion 36 Directors and officials of the several associated Companies entertained him to dinner and made presentations. Acknowledging these and the toast of his health Mr. Ernest related reminiscences of his 63 years' association with the Company and the gas industry at home and abroad.

MR. WILLIAM LUCAS, of Kingston; MR. ALEXANDER ROACH, of Hampton; and MR. CLIFTON COLEMAN, of Malden, have received the Royal Humane Societys' certificate for their attempt at great personal risk, to save the life of a work-mate who collapsed while inspecting a gas-holder at Kingston gasworks last December. The presentations were made by the Mayor of Kingston, Councillor C. M. Judge.

MR. VICTOR BURROWS, who had been Northern Gas Board District Superintendent at Seaham (County Durham) since 1955, has been appointed to the same post at Blyth (Northumberland). Both towns are coal-exporting centres. MR. OSWALD WILLEY has succeeded Mr. Burrows at Seaham.

Obituary

MR. R. H. WESTON, London Manager of Jackson Boilers Ltd., has died after a short illness. He had been with the Company since 1926.

De La Rue Company

The effective date for the change of name of Thomas de la Rue and Co. to the De La Rue Company will be August 14. On the same date the security printing division will commence operations as Thomas de la Rue and Co., and the Potterton division as Thomas Potterton.

Christian Fellowship

Following the last annual meeting of the London Federation of Christian Unions, a number of Christians employed in the North Thames Gas Board formed the Gas Industry Christian Fellowship. The Fellowship is interdenominational and those in sympathy are asked to write to the Chairman, Mr. G. E. Warner, 23, Brinklow Crescent, London, S.E.18.

Gas Industry's Role in New Trunk Road Construction

Pictured above is one of the North Thames Gas Board's tar tankers engaged in tar spraying operations on the new London to Yorkshire motor road—the first major road-building project to be authorised by the Government for many years. In the face of keen competition, the N.T.G.B. won the contract for the first two sections of the road—25 miles running north from Luton, Bedfordshire. It will require 240,000 gal. of tar, the coverage being 3-4 sq. yd. per gal. This tar will form a waterproofing for the first course in the road's construction, and will be sprayed on the 6-in.-deep granular sub-base. It will also make the surface suitable for carrying constructional traffic.

★

GAS COOKING AT THE NATIONAL EISTEDDFOD

Mr. Mervyn Hughes, caterer; Mr. G. R. Davies, Assistant Secretary, Wales Gas Board; Mr. D. S. Davies, Engineer and Manager, Ebbw Vale; and Mr. T. Mervyn Jones, Chairman, Wales Gas Board, inspect gas appliances installed to cook some 50,000 meals for visitors to the National Eisteddfod at Ebbw Vale.

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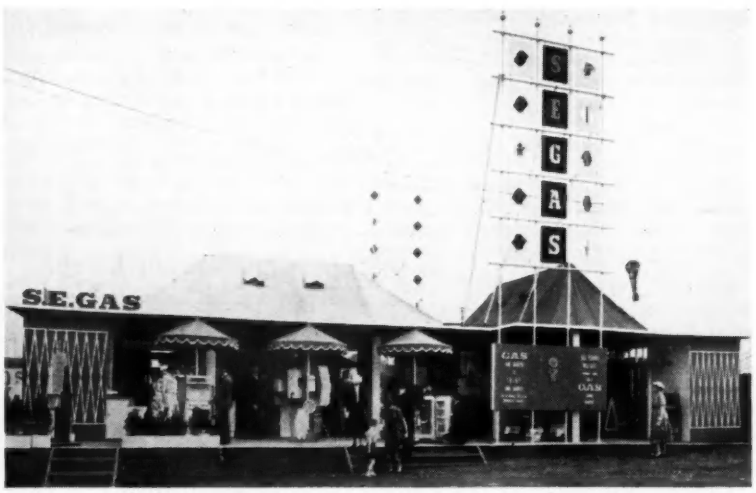

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GAS AT THE KENT AGRICULTURAL EXHIBITION

Pictured left is the South Eastern Gas Board stand at the recent Kent Agricultural show at Maidstone. The exhibit included a complete range of domestic gas and coke appliances. There was also an industrial section showing central heating, catering, and overhead heating appliances.

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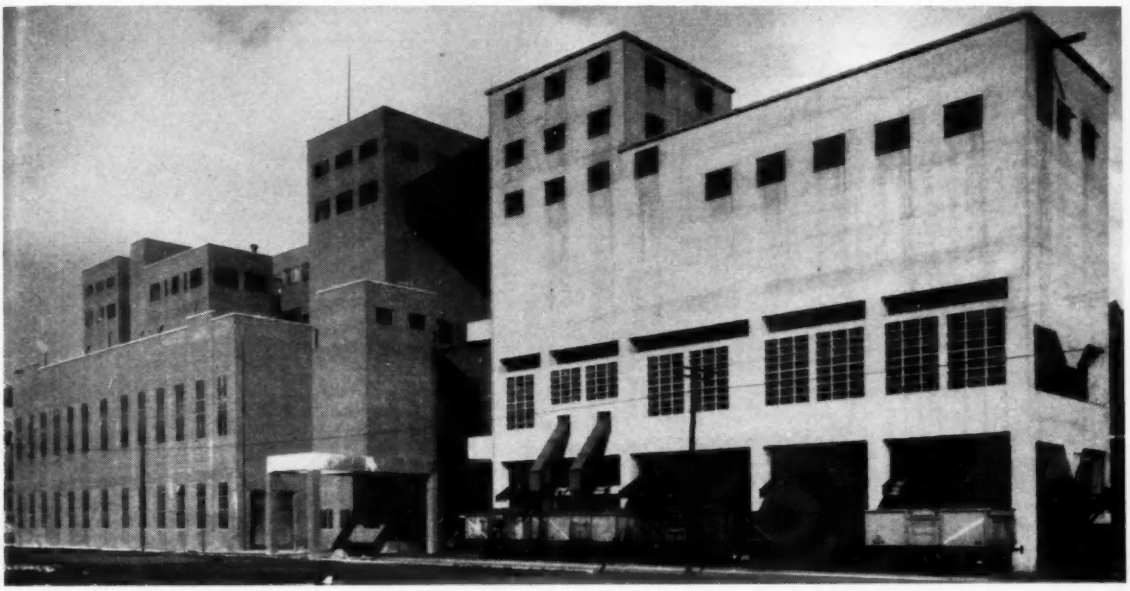
PROVAN EXTENSIONS OPENED



Continuous vertical retort house and coke screening plant.

NEW plant with a total capacity of more than 15 mill. cu.ft. of gas a day was declared officially open at the Provan works of the Scottish Gas Board on Monday, when the Lord Provost of Glasgow officiated at an inaugural ceremony to mark the completion of extensions at this works.

Earlier extensions, completed in 1922, comprised the largest single Woodall-Duckham continuous vertical retort plant in the world—192 retorts, with a capacity of 18 mill. cu.ft. per day, under one roof. In 1940, two Humphreys & Glasgow carburetted water gas plants, each with a capacity of 4 mill. cu.ft. per day, were installed, and they were followed by a third unit three years later.

The present extensions will add 7.04 mill. cu.ft. of coal gas by the commissioning of 48 Woodall-Duckham continuous vertical retorts, and 8 mill. cu.ft. per day of carburetted water gas from a new installation of two Humphreys & Glasgow 'labourless' units each of 4 mill. cu.ft. per day.

The present capacity of the Provan gasworks is 27.5 mill. cu.ft. per day, but this is to be further augmented to 30 mill. cu.ft. per day by coke oven gas from Bairds and Scottish Steel Ltd. and purified at the Scottish Gas Board's station at Hollandhurst. Further coke oven gas supplies from Bairds and Scottish Steel Ltd. and Colvilles Clyde Iron Works Ltd., and methane from Cardowan colliery are expected to increase the volume of gas handled at Provan to 40 mill. cu.ft. per day by 1960.

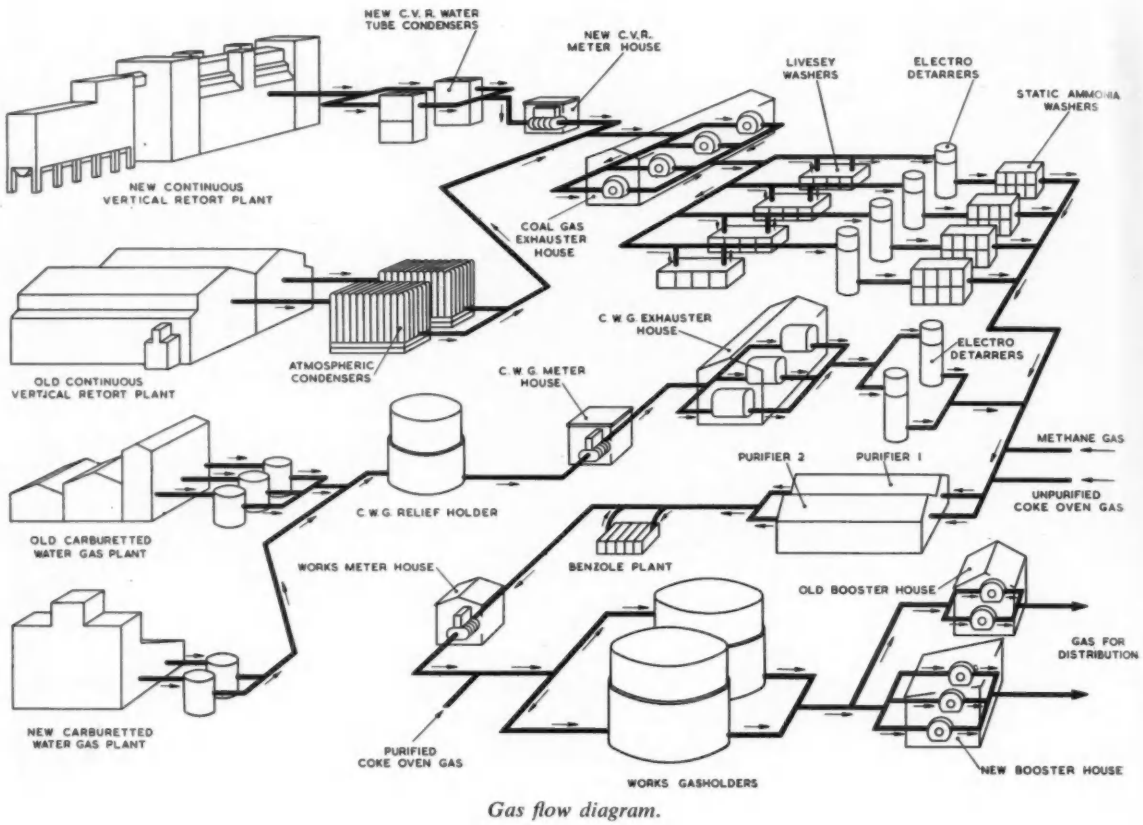
The chief contractors for the new carbonising plant, including the coal and coke handling plants, are the Woodall-Duckham Constructional Co. Ltd. This plant comprises two benches each of 24 Woodall-Duckham lambent heated continuous vertical retorts, capable of carbonising a total of 435 tons of coal per day and of producing 7.04 mill. cu.ft. of gas with a calorific value of 450 B.t.u. per cu.ft.

The two retort benches are built in line and each is divided into six sections by transverse air-cooled division walls which enable any section to be repaired without affecting the working of the others. The retorts, 26 ft. high by 82 in. long by 10 in. wide at the top tapering on the minor axis, are so arranged that any one retort can be controlled independently of the others. Upward heating is employed.

Producer gas is admitted and controlled from a single point on each side of each retort, the preheated secondary air for combustion being introduced at three or more levels. The retort seating castings and supporting steelwork are cooled by the circulation of the secondary air which safeguards them against overheating and reduces the producer fuel consumption by 7 to 10%.

Coal is delivered to the works in rail waggons on elevated sidings within the coal store. Coal required for immediate use is discharged into a concrete receiving hopper by an electrically operated Strachan and Henshaw rotaside waggon tippler, controlled from an adjacent brick-built control cabin. This hopper is provided with a 14 in. mesh grid covering to prevent the entry of oversize coal, and its sloping sides are blue brick lined. Suitable provision has been made for a possible future arrangement of coal feeding.

Duplicate coal conveying systems each capable of handling 80 tons of coal per hour, provide a standby in case of breakdowns. Beneath the bottom outlets of the hopper are two Locker-Traylor vibrating feeders, each of which delivers the coal to a British Jeffrey Diamond single roll breaker, or alternatively on to a by-pass chute when small coal only is being handled. The breakers and by-pass chutes feed on to duplicate belt conveyors which carry



Gas flow diagram.

the coal through a concrete tunnel beneath the coal store and discharge it by way of rotary fillers on to the gravity bucket conveyors encircling the west end bay of the retort house.

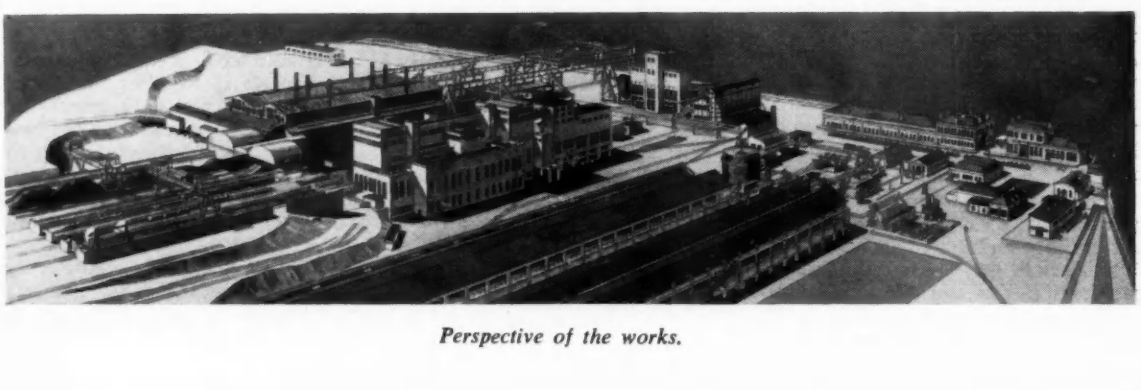
There are also facilities for reclaiming stored coal, which may be either returned to the receiving hopper by waggon or delivered through openings in the tunnel roof on to travelling feeders and thence to the tunnel conveyors. The amount of coal passing over the tunnel conveyors is recorded by Adequate weighers located after the final feed point from the coal store.

The duplicate gravity bucket conveyors elevate the coal and deliver it by belt and reversible shuttle belt conveyors into the overhead storage hoppers above the two retort benches. These hoppers have a capacity of 60 hours' requirements of the retorts and are divided into sections serving 12 retorts. Coal is fed from bottom outlet doors through rotary valves into the auxiliary supply hoppers attached to the top mouthpieces of the retorts.

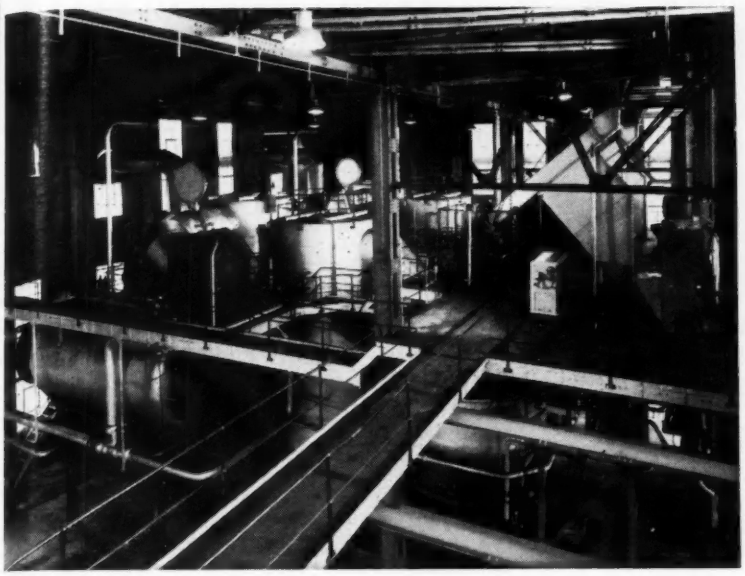
Gas leaves the retort through a liquor sprayed offtake and passes, via a liquor sealed dish valve, into the collecting main. Each bench is provided with two collecting mains which are arranged with a fall towards the tar and liquor overflow and cleaning well at the centre. The tar and liquor is run off to separating tanks. The liquor is decanted and pumped back to the sprays in the offtakes and collecting mains and the tar is drained off at intervals. There are two separating tanks, one serving each bench, and three steam driven liquor circulating pumps, one for each bench with a common standby.

The gas leaves each collecting main by a vertical uptake and passes to a foul main above. The foul mains are extended to the centre bay between the retort benches where the two mains from each bench are coupled into a common main fitted with a Bryan Donkin retort house governor. The crude gas then passes from the retort house and is carried by a suction main to the condensers. Henry Balfour Ltd. were the suppliers of the gas mains.

The coke extractors are rotated by rocker arms actuated by reciprocating



Perspective of the works.



Carburetted water gas plant.

bars extending the length of each bench on either side and connecting through fixed eccentrics to overhead driving shafts. The two electric motors and two vertical single-crank non-condensing steam engines are provided, with one motor and one engine serving each bench.

Producer gas for heating the retorts is supplied by three 9 ft. diameter Humphreys & Glasgow mechanical producers gasifying ½-in. to 2-in. coke. Each is capable of serving 24 retorts with one acting as a standby. The gas generated is passed through cyclone dust separators and enters the retort settings through the producer gas main, the pressure in which is controlled by an Askania automatic gas regulator.

Annular boilers generating steam at 20 lb. per sq. in. gauge, supplemented by the works low pressure system, supply steam to saturate the air blast. Boiler feed water requirements are supplied by two steam driven feed pumps. Air blast is provided by two blowers, one electrically driven and the other steam driven, either of which is capable of supplying two producers with one acting as a standby.

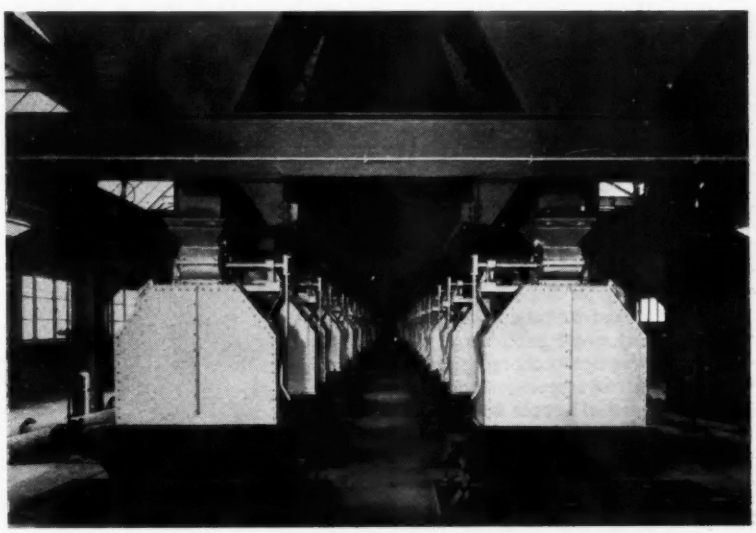
There are three waste heat boilers each large enough to deal with the waste gases from 24 retorts, with one boiler acting as a standby. They are of the horizontal fire-tube induced draught type, 7 ft. 9¾ in. in diameter and 15 ft. long, and are designed for a working pressure of 160 lb. per sq. in. gauge, with a capacity of 16,300 lb. of steam per hour and 100° F superheat. Feedwater requirements are provided by two vertical single-cylinder direct acting steam driven feed water pumps, one acting as a standby and an enclosed tubular type feed water heater. Each boiler is fitted with an induced draught fan driven either by an electric motor or steam turbine, and a superheater at each inlet flue.

Facilities for admitting augmentation gases from each mechanical producer up to the equivalent of waste gases from eight retorts enable the boilers to be maintained at their full rated capacity when only 16 retorts of either bench are in operation. If necessary all three boilers can operate simultaneously when supplied with maximum waste gases from the retorts and full augmentation from two producers. The waste gases leaving the boilers pass through waste gas discharge pipes to the chimneys, one of which serves each bench of retorts. Each chimney is of brick-lined steel construction and is fitted with an automatic draught regulator.

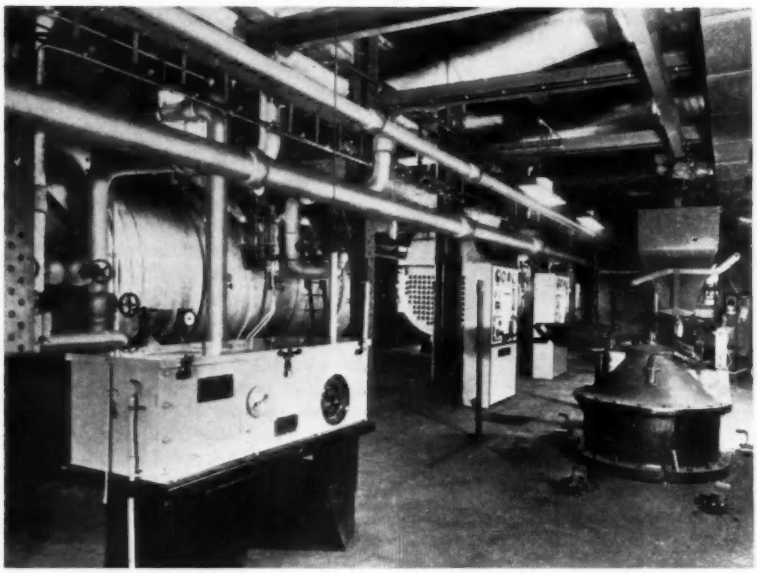
The coke is discharged from the hoppers beneath the retorts through travelling coke chutes, running on rails laid in the retort house floor, on to either of duplicate belt conveyors arranged in a trench below floor level. Each conveyor is capable of handling 40 tons of coke per hour which it delivers by means of rotary fillers on to gravity bucket conveyors encircling the east end bay of the retort house. The coke is delivered to the screening and storage plant by duplicate conveyors, fitted with Adequate weighers and running in a steel-framed gantry.

The coke screening and storage plant is of reinforced concrete construction, built in line with the retort house and accommodating duplicate screening systems, one of which is a standby, over a range of storage bunkers. Each screening system is capable of handling 40 tons of coke per hour and comprises a single-deck Pegson vibrating scalping screen separating at 2 in., followed by primary and secondary Jenkins reciprocating grading screens separating into three sizes, 0 to ½ in., ½ in. to 1¼ in. and 1¼ in. to 2 in. The four grades of coke are delivered into their respective compartments of the storage bunkers, spiral chutes being used for the largest size and a system of feeder and shuttle belt conveyors for the oversize from the grading screens. The two screening systems are separated by a concrete division wall to facilitate repairs.

The range of bunkers beneath the screens has a total storage capacity of 600 tons of coke and breeze. The



Top charging platform and auxiliary coal hoppers.



Mechanical producer charger platform and waste heat boilers.

compartments are blue-brick lined on the sloping sides and are fitted with cast iron outlets at the bottom. All but the smallest size of coke is delivered by bifurcated chutes and Pegson travelling debreezing screens to rail wagons on one side and to road vehicles or portable Belle Isle weighing and bagging machines on the other. On the rail loading side there is also provision for feeding coke of sizes ½ in. to 1¼ in. and 1¼ in. to 2 in. on to a belt conveyor for return to the retort house as producer fuel.

Breeze from the smallest size compartment of the coke bunkers is fed direct to rail wagons or road vehicles by chutes in which provision has been made for the future installation of dedusting screens. Fine breeze from the debreezing screens is delivered to a continuous reinforced concrete hopper beneath the bunkers from which it is discharged on to a belt conveyor for loading either direct into road vehicles or by portable conveyor into rail wagons.

Within the retort house the graded coke for the producers is delivered from the conveyor down a spiral chute and by rotary fillers to the coke gravity bucket conveyors, and thence by a system of belt conveyors to the 69 tons capacity producer fuel hopper which is arranged within a brick tower over the mechanical producers. An electrically-propelled charging skip, running on an overhead rail, delivers the coke from the hopper to the producers as required, the amount being recorded by Avery automatic weighers and totalisers.

Run-of-retort coke required for filling the retorts at starting-up and after scurfing is stored in two overhead coke hoppers, one in the east end bay and the other in the centre bay between the retort benches, each with a capacity of 7 tons. From the top strand of the gravity bucket conveyors the coke is delivered direct to the east end bay hopper and by conveyor to the centre bay hopper. Two top hung, hand-propelled retort filling skips, one serving each bench, deliver the coke from the hoppers to the retorts as required.

Ash and clinker from the mechanical producers are collected in hand-propelled skips which are subsequently elevated by a Humphreys & Glasgow electrically-operated skip hoist and discharged into an overhead ash storage hopper of 45 tons capacity. Ash is discharged at intervals into rail wagons beneath.

To prevent dust or smoke nuisance, dust extraction hoods are fitted at the coke dischargers and connected by ducting to two Drummond washer filter units located outside the retort house. An electric motor-driven fan works in conjunction with both washers, beneath which concrete pens are provided to drain the washing medium and to collect the deposit material.

A Sturtevant vacuum cleaning plant is provided to serve both the retort house and the coke screening plant. Numerous hose coupling points are connected to the turbo-exhauster and filter receiver unit which is installed at ground level in the east end bay of the retort house. Dust collected in the receiver is then passed to the Drummond washers for treatment.

All the electric motors associated with the carbonising plant are of the totally enclosed, dust and weather-proof gasworks type. The control gear for the motors operating the coal and coke handling plants is centralised and sequence interlocked so that the units of each system can only be started and stopped in their correct order.

The incoming electrical supply is of 415/240 volts, 50 cycle, 3/1 phase, 4-wire alternating current, which is handled through a distribution switchboard accommodated in an enclosed room within the retort house. The board incorporates a bus-bar chamber and twelve oil-immersed circuit-breakers. In addition there is a lighting switchboard to control internal retort house lighting, and a sub-distribution board for the coal-tippler, coal

Mechanical producer grates and cyclone dust extractors.

Main electrical sub-station.

feeder and coal breaker motors and control gear.

The new carburetted water gas plant consists of two Humphreys & Glasgow labourless units which together are capable of producing 8 mill. cu.ft. of 450 B.t.u. gas per day. It adjoins and supplements the existing water gas installation, and is housed in a steel-framed brick building of sufficient size to accommodate a third unit in the future.

The plant is hydraulic and fully automatic in operation and includes provision for heavy oil enrichment should this be desired. Incorporated in the units are water-sealed self-clinkering generators, chequered carburettors and superheaters, and elevated washers with conical bases for sludge discharge. The generators are complete with coke chargers, top gas chambers equipped for heavy oil spraying, and low pressure annular boilers producing steam for the process. The carburettors are designed for the gasification of either gas oil or heavy fuel oil, an alternative arrangement which involves a considerable increase in the size of the vessels to accommodate chequered air preheating zones required when heavy oil is being used. Horizontal fire-tube waste heat boilers operating at 165 lb. per sq. in. gauge provide high pressure steam for the works system.

Coke for the plant is discharged from road vehicles into a concrete feed hopper and elevated by twin independent skip hoists, each capable of handling 20 tons of coke per hour. A system of feeder and shuttle belt conveyors distributes the coke throughout the overhead bunkers, each of which has storage space for 170 tons of fuel. Cascade debreezing screens in the generator feed chutes separate the breeze which is collected in a traverse skip and transported to a breeze storage hopper of 42 tons capacity. Ash is discharged from the generator grates into manually operated skips which are elevated by a skip hoist and discharged into a 56-ton ash storage hopper feeding both road lorries and rail wagons. Mechanical handling of ash skips on the ground is proposed for the future.

Ancillary equipment installed with the c.w.g. plant includes two Humphreys & Glasgow vertical tube multipass condensers to cool the gas before it passes into the existing relief holder. After leaving the holder, and before passing to the exhausters, the gas is measured by a Holmes-Connersville positive displacement type meter, fitted with labyrinth seals and capable of handling 625,000 cu.ft. of gas per hour.

There are three steam driven Waller Roots exhauster sets, supplied by George Waller & Son, Ltd., each with a capacity of 340,000 cu.ft. of gas per hour when running at a speed of 430 r.p.m. against a pressure difference of 32 in. w.g. The exhausters, which are direct-coupled to single cylinder steam engines operating on steam at 140 lb. per sq. in. with 60°F. of superheat, are provided with tachometers to control variations in the gas output between 340,000 and 145,000 cu.ft. per hour as required. Two 24 in. diameter by-pass valves are also installed and arranged to open as the relief holder falls to a predetermined level.

From the exhauster house the gas passes through two Whessoe W-D electrostatic detarrers, capable of dealing with a total 16 mill. cu.ft. of gas per day, and thence into the coal gas stream before being purified.

The gas from the retort house passes through a 36 in. diameter steel welded overhead main to the Newton Chambers primary gas condensers for cooling. (Both mains and condensers were supplied by Newton Chambers, Ltd.) There are two condensers of the vertical water-tube type arranged to work in parallel and together they are capable of cooling 8 mill. cu.ft. of gas per day. Each unit is equipped with six passes for gas and water flow, and a total cooling surface of 4,000 sq. ft. Facilities include provision for the use of both canal and town water in separate streams, and there are water flow controllers to maintain a predetermined temperature at the gas outlets. In the cooling process the town water is suitably preheated for use in the waste heat boilers of the retort house.

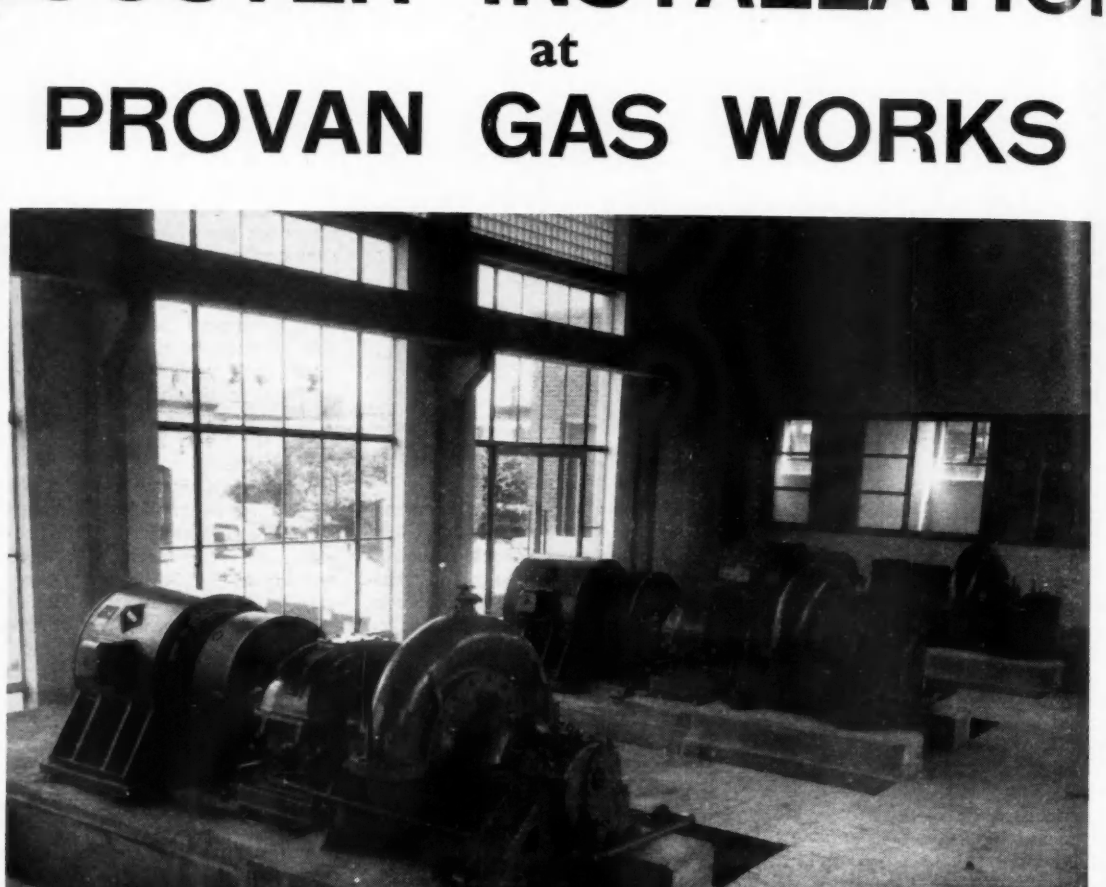
A 24 in. diameter overhead main carries the gas from the condensers to a Holmes-Connersville positive displacement type meter with a rated capacity of 275,000 cu.ft. of gas per hour. The meter is fitted with labyrinth seals for measuring unpurified gas. The gas then passes into the existing gas stream from the old retort house to the turbo-exhausters and thence through the wet purification plant to the purifiers.

New Purifiers

The new purifiers (in course of completion) will increase the purification capacity of the station by 7 mill. cu.ft. per day. They are of reinforced concrete construction and consist of two sets of five boxes, each 40 ft. square by 6 ft. deep with a 3 ft. depth of oxide in single layer. A revivifying floor is constructed above the boxes and the whole installation is roofed over. The boxes are charged with oxide by means of chutes from the revivifying floor directly above, and the arrangement obviates the need for costly mechanical handling plant. The installation was designed in entirety by the Divisional engineering staff. Much of the cast iron pipe and fittings were supplied by the Staveley Iron & Chemical Co., Ltd.

The gas manufactured in the continuous vertical retort and carburetted water gas plants, is augmented by purified coke oven gas from the Scottish Gas Board's Hollandhurst station at Gartsherrie, and the total quantity of gas made and imported, including all future supplies, will pass from the holders to the booster house (in course of completion) for distribution. There are three Bryan Donkin turbo

BOOSTER INSTALLATION at PROVAN GAS WORKS



Photograph by courtesy of the Scottish Gas Board

Illustration shows three OLP Turbo Boosters in the course of installation, each machine capable of a duty of 750,000 cubic feet of gas per hour, against an outlet pressure of 6 lbs. per square ins.

THE BRYAN DONKIN COMPANY LIMITED

CHESTERFIELD LONDON TORONTO

boosters, with provision for a fourth, of the Donkin Rateau single stage radial-vaned centrifugal type, each with a capacity of .75 mill. cu.ft. of gas per hour against an outlet pressure of 6 lb. per sq. in. gauge. The sets are arranged to work in parallel by a system of sequence operation which is automatically controlled by the demand. A by-pass and anti-surge device fitted to each booster ensures that there will be no hunting when the machines are operating in parallel. The booster plant itself was supplied by the Bryan Donkin Co. Ltd. and gas isolating valves by the Audley Engineering Co. Ltd.

The boosters are driven by Trislot type double pipe ventilated induction motors manufactured by Laurence Scott and Electromotors Ltd., and designed to operate on a 3.3kV, 3 phase, 50 cycle supply and to be capable of an output of 500 h.p. at 1,480 r.p.m. Each motor is provided with a ventilating fan unit complete with flameproof driving motor, a totally enclosed high speed increasing gear unit with forced lubrication, and a scoop control fluid coupling working in conjunction with a gas governor to maintain, by variable booster speeds, a constant pressure in the outlet main. The three governors are inter-connected to a single control point on the instrument panel. There is also provision for manual regulation of the fluid couplings should this be necessary.

Automatic Cut-out

The motors are protected for overload and should any failure take place either with motor, gear box or booster, the set will cut out and the standby machine will take over automatically.

The instrument panel in the booster house is divided into two sections, one for electrical equipment and the other for gas equipment showing inlet and outlet pressure flows. Push-button starters and motor selector switches and ammeters are incorporated as well as a series of operational pilot lights.

The new electrical installation is controlled from a main substation, secondary substation and five local distribution switchrooms.

In order that continuity of supply be maintained, duplicate feeders from two separate points on the South of Scotland Electricity Board's network have been brought into the main substation. This supply is 6.6 kV, 3 phase, 50 cycle and is fed into a nine-panel switchboard. From this switchboard, which has been sited in the centre of the load area, 6.6 kV feeders radiate to the secondary substation and the new booster house substation. The high tension supply to the new booster house substation is transformed by two 1,000 kVA 6.6 kV transformers to feed through the seven-panel 3.3 kV switchboard to the automatic starters controlling the three 500 h.p., 3.3 kV, 3 phase squirrel cage, direct-on-line, pressurised motors driving the boosters.

Main sub-station H.T. switchboard.

The main and secondary substation high tension switchboards each supply two local transformers, rated 500 kVA, 6.6 kV/415 volt, 3 phase, which provide the low tension supply to the works. The 6.6 kV switchboards are of metal enclosed vertical isolation, horizontal drawout, cubicle type with spring closing and remote electrical release, each switchboard incorporating two fault making, fault breaking J11 oil immersed isolators, and one non-automatic bus-section switch. The switchboards are A.S.T.A. certified 250 MVA and incorporate triple-pole, non-directional induction pattern relays having definite minimum inverse time limit characteristics, each relay with two elements wound for overcurrent protection and one element wound for earth leakage protection.

The 3.3 kV switchboard is A.S.T.A. certified 150 MVÁ and incorporates the above protection on the two incoming panels, while the outgoing panels which supply the 500 h.p. motor circuits are fitted with three thermal overload elements, two instantaneous short circuit elements and one earth leakage element.

The four 500 kVA, 6.6 kV/415 volt transformers and the two 1,000 kVA, 6.6/3.3 kV transformers are all of the outdoor type incorporating oil conservator, silica gel breather and off-load tap-changing switches. All the above switchgear and transformers were supplied and installed by the Brush Electrical Engineering Co. Ltd.

The four 500 kVA transformers supply the 415 volt, 3 phase, 50 cycles low tension switchboards in the main and secondary substations. The switchboards are of the oil-immersed, horizontally isolated, draw-out type with eight circuits and eleven circuits respectively.

Each switchboard incorporates two 800A circuit breakers and one on-load 800A bus-section switch. The feeder circuit breakers are 400A and 600A capacity and control the low tension ring-main and radial feeders to the five local distribution switchrooms. Each circuit breaker is fitted with overcurrent protection, an ammeter and a kWh meter. An earth leakage recorder, with alarm relay, and a power factor indicator are fitted to each switchboard. The 415 volt low tension switchboards are A.S.T.A. certified 25 MVA and are of the new GEO type of oil-immersed circuit-breaker, manufactured and supplied by George Ellison Ltd.

Much of the paint used on the Provan extensions was supplied by Graphite Products, Ltd. Plant on which it was used includes the Humphreys & Glasgow c.w.g. plant; it was also used on the Woodall-Duckham structural work in the retort house, on stanchions, roof trusses, and main structure, as well as on old and new condensers.

The steel work of overhead hoppers, the ash and breeze hoppers, the dust arresting plant and stack valve platform, the stairways and platform, superheaters, carburetteors, and generators, and the pump room all received an application of silica graphite paint in whole or part.

Recovery of Heat from Incandescent Coke by Sulzer Dry Cooling Process

WHEN coal is carbonised in gas and coke works, incandescent coke at a temperature of 950°C. to 1,100°C., according to plant and carbonising time, remains behind in the ovens or retorts. This coke still contains a fairly big percentage of the heat supplied to the heating flues by solid or gaseous fuels during the distillation period. After being expelled from the ovens or retorts on the completion of degasification, this incandescent coke must be cooled as quickly as possible to prevent it from burning in the atmosphere. The commonest method of cooling in general use is wet 'quenching'; in Switzerland, however, this method has already become a rare exception. It is obvious that wet quenching involves the loss of very great amounts of heat and that it also requires a substantial supply of water. This is perhaps best illustrated by an example.

High Losses

Assuming that a plant produces 3,000 tons of coke per day, the heat lost by wet quenching of this coke would suffice to run an electric generating station with a constant output of 7,500 kW, or in other words to produce about 180,000 kWh of useful power per day. The water needed for quenching the coke would amount to about 3,000 cu. m. per day or 125 cu. m. per hour. This water would of course have to be pumped, which would make further demands on the power supply of the coke works.

Quite apart from these serious losses of heat, however, wet quenching has a number of other disadvantages. The abrupt cooling from a temperature in the neighbourhood of 1,000°C. causes the single pieces of coke to crack, sometimes only superficially, sometimes through the centre. This leads to an increase in breeze or dust, the total amount of which may differ by several per cent. according to the quality of the coke. Even medium and large pieces of coke will crack in this way, so that they later break completely during transport or on delivery at their destination, with further breeze formation. In the same way cracked coke will break up in the blast furnace, where it is subjected to high pressures, and this may result in irregular blast and local congestion.

Wet quenching also involves the corrosion of transport equipment, quenching towers and nearby buildings as a result of the sulphurous vapours produced. In winter, the operation may also be upset by ice formation on the coke cars and at the quenching stations. The resulting upkeep costs are extremely high, and it would certainly be worth while to investigate them separately, i.e., apart from all other plant maintenance, but including the indirect damage to buildings as a result of corrosion.

The idea of replacing the wet quenching of coke by some more economical method occurred many years ago. Of all the proposals put forward, the use of inert gases as a medium of heat transfer proved to be the most promising, as it has the advantage of cooling the incandescent coke very gently and in the dry state. It was therefore on these lines that the Sulzer dry coke cooling process was developed from 1917 onwards, leading to plants which today are able to meet the requirements of the very largest gas and coke works.

The sensible heat contained in the incandescent coke is carried by the inert gases to a heat exchanger, which may take the form of a steam boiler, a high-pressure hot-water boiler (sometimes combined with a storage tank), a feed-water preheater, a combustion air preheater or the like. This exchanger may also serve as a main heat producer or as a preheater stage for an open or closed gas or air turbine cycle.

Fig. 1 shows diagrammatically the principle of heat transfer from the incandescent coke to the exchanger. This diagram applies to all the embodiments of the Sulzer dry coke cooling system described below. The cooling chamber or bunker 1, heat exchanger 2, cooling gas fan 3 and ducts a + b + c together form an enclose practically gastight circuit. During the cooling process, fan 3 keeps in inert gas in constant circulation in this circuit. The gas absorbs the sensible heat of the incandescent coke in chamber 1 and gives it up in exchanger 2 to the secondary heat-carrying medium.

The process permits uniform cooling of the coke combined with much gentler treatment than is possible in the wet quenching process, as cooling is here spread over a longer period of time. The actual cooling period and the arrivals of charges from the ovens must, of course, be co-ordinated in advance, while the dimensions and the maximum capacity of the coke cooling plant must be chosen so that idling periods are kept

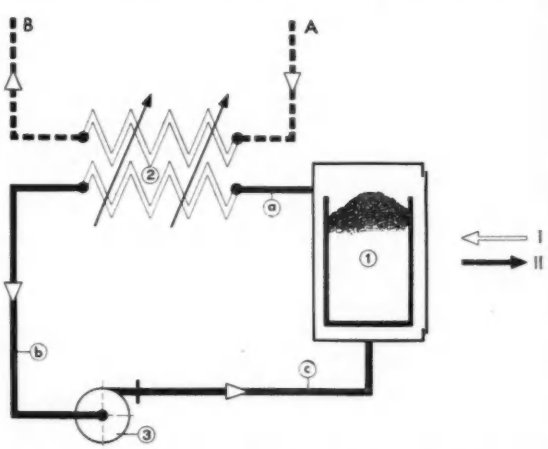


Fig. 1. Principle of the Sulzer dry coke cooling system. A Secondary heat carrier (inlet); B secondary heat carrier (outlet, useful heat); a, b, c cooling-gas circuit; 1 cooling space with incandescent coke; 2 heat exchanger; 3 cooling-gas fan set; I introduction of incandescent coke; II removal of cooled coke.

very short or eliminated altogether. The inert cooling gases consist mainly of nitrogen and carbon dioxide, with a small amount of carbon monoxide and hydrogen and negligible traces of oxygen.

The cooling gases are inert, for the purpose in view, because of the almost complete absence of oxygen, as a result of which they cannot in practice cause any burning of the incandescent coke. Even the air present in the system at the commencement of the cooling process—particularly that entering the chamber-type plant when the coke is introduced—is in this respect negligible. Provided that the circuit is gastight, the limited amount of oxygen initially present is soon exhausted by the burning of the gases still emitted in small quantities by the incandescent coke.

The heat which can be extracted from the incandescent coke coming from the ovens is calculated by the equation:

$$W = G \cdot (cm_1 \cdot t_1 - cm_2 \cdot t_2). \qquad (1)$$

where

W = heat extracted from coke of weight G when cooled from
t_1 = initial temperature to
t_2 = final temperature;
c_{m1} = mean specific heat of coke between t_1 and +20°C,
c_{m2} = mean specific heat of coke between t_2 and +20 °C.

The specific heat of coke was determined in the course of scientific investigations carried out by Prof. Schläpfer and Debrunner of the Swiss Federal Institute for the Testing of Materials in Zurich. The following equation permits the mean specific heat of any type of coke to be calculated from its analysis and as a function of temperature:

$$c_m = \frac{x}{100} \cdot c\,a + \frac{y}{100} \cdot c'k + \frac{z}{100} \cdot \frac{1}{s} \cdot c'g \qquad (2)$$

where

c_m = mean specific heat of coke between temperature t and +20 °C,
x = ash content in per cent by weight,
y = solid carbon content in per cent by weight,
z = volatile constituents in per cent by weight,
c'_a = mean specific heat of ash (between t °C and +20 °C),
c'_k = mean specific heat of carbon (between t °C and +20 °C),
c'_g = mean specific heat of gas per unit volume
s = specific gravity of gases (0.46 to 0.5 at 15 °C and 760 mm. Hg).

To give an example: The mean specific heat of a coke type of the following composition—

ash $x = 10.6\ \%$
solid carbon $y = 87.35\ \%$
volatile constituents $x = 2.05\ \%$

between temperatures of 1,000 °C and +20 °C is:

$$c_m = \frac{10.6}{100} \cdot 0.255 + \frac{87.35}{100} \cdot 0.363 + \frac{2.05}{100} \times \frac{1}{0.48} \cdot 0.324 = 0.358 \text{ kcal. per kg.}$$

If a ton of incandescent coke at a mean temperature of 1,000°C. is wet quenched, the heat loss according to equation (1), and on the assumption of a final temperature of +20°C. and a known mean specific heat is:

$W = 1{,}000 \cdot (0.351 \cdot 1{,}000\text{-}0.17 \cdot 20) = 347{,}600$ kcal.

On the other hand, at a yield of 0.7, this ton of coke corresponds to a coal throughput of

$$\frac{1.0}{0.7} = 1.43 \text{ tons}$$

If we further assume the fuel needed for the distillation process to be 13—20% of the coal throughput, the fuel required for producing 1 ton of coke is (0.13....0.2) 1,430 = 186—286 kg.

At a net calorific value of, say, 7,170 kcal. per kg., these figures correspond to a heat consumption of (186....286) 7,170 = (1.335—2.05) 10^6 kcal. If we now compare the heat consumption for the production of a ton of coke with the heat loss due to wet quenching, we find the latter to be

$$\frac{347{,}600}{1.335 \cdot 10^6} \cdot 100 \ldots\ldots \frac{347{,}600}{2.05 \cdot 10^6} \cdot 100 = 26—17\%$$

If the ovens or retorts are heated with gas instead of coke, the above values must be modified accordingly. It is clear from these figures that a substantial proportion of the heat required for the distillation process is lost during wet quenching, whereas it can be largely recovered and put to use by adopting the dry cooling process.

For economic reasons the incandescent coke is not cooled to the ambient temperature, but only to between 250°C. and 350°C., so that it averages 300°C. This is the temperature at which the coke no longer ignites when spread out in the open air. It is also a figure which does not demand excessively large and therefore uneconomical heat exchanging surfaces.

The optimum method of utilising the heat recovered depends on the nature of the plant in which the coke is produced. Steam may be generated at suitable pressures, and this is the alternative usually preferred. Otherwise combustion air or feed water may be preheated, high-pressure hot water may be produced and stored, coal may be dried in gas and coke works, or

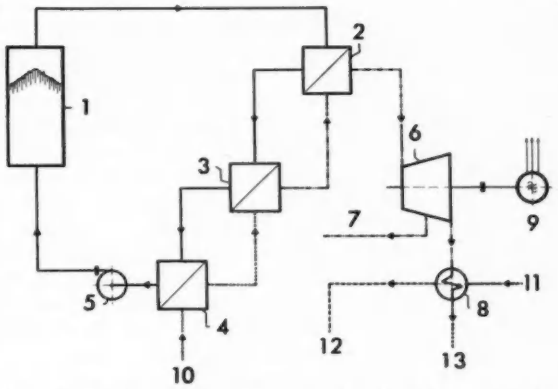


Fig. 2. Coke cooling plant combined with condensing steam turbine. 1 Coke cooling plant, 2 steam superheater, 3 steam boiler, 4 feed-water preheater, 5 cooling-gas fan, 6 steam turbine, 7 process steam extraction, 8 condenser, 9 generator, 10 feed water, 11 cooling-water inlet, 12 cooling-water outlet, 13 condensate.

electricity may be generated by the use of a gas turbine.

The useful heat available at the outlet of the exchanger does not depend only on the initial and final temperatures of the incandescent coke but also on the efficiency of the whole cooling system. The efficiency figure allows for all the losses occurring during the cooling process, including heat transmission and radiation to the outside. Experience has shown that in normal operation the efficiency of Sulzer dry coke cooling plants lies between 0.8 and 0.95.

It has been shown that about 235,000 kcal. of useful heat, after deduction of all losses, can be recovered per ton of coke with the dry cooling process. The heat losses per ton of coke produced, on the basis of the fuel consumption of the ovens, are accordingly not 26—17%, as with wet quenching, but only about 9—5%. The savings are thus considerable.

The three types of Sulzer dry coke cooling plants—bunker, chamber and fire-tube types—differ in the design of the cooling spaces and to some extent in their operating features. The principle of heat exchange is common to all three, a slight modification being apparent only in the fire-tube type, which in any case is only suitable for small gasworks, while the chamber and bunker types are built for medium and large throughputs, irrespective of the oven or retort capacity. Large plants may well handle as much as several thousand tons of coke per day. For coke charges of 12 tons or over, corresponding to oven chamber or retort capacities of 17 tons of coal or more, only bunker or chamber type plants can be used.

The choice of the plant type depends on a number of factors and can only be made after due consideration of all aspects of operation. Some of the more important of these factors are the type of the ovens or retorts and the method of discharging them, the transport medium used for the incandescent coke, the emptying system, space conditions in the works and the quality of coke required.

Generally speaking, experience suggests that the coke works of the steel industry prefer the chamber type. The explanation is that with this system the coke is handled only when pushed from the ovens into the coke skip and emptied from the latter on to the wharf, so that breeze formation is kept to a minimum.

Some competent engineers in the steel industry, however, point out that the bunker type ought really to be given the preference over the chamber type precisely because of the higher mechanical stressing of the coke; for large pieces of coke which are already weakened by cracks are broken as they go through the cooling bunker, with the result that a medium-sized coke of high strength is produced that stands up very well to the compressive loading of the blast furnace. The screening of the coke after the dry cooling process is also easier and more effective, so that a minimum of breeze finds its way into the furnace. The distribution of the air blast in the reduction zone is consequently more uniform, and the reducing process is improved accordingly.

Another factor on which the choice of bunker or chamber type may depend is steady steam generation. While the relatively high capacity of the bunker ensures little fluctuation of steam production and thus of steam pressure, more pronounced fluctuations may occur with

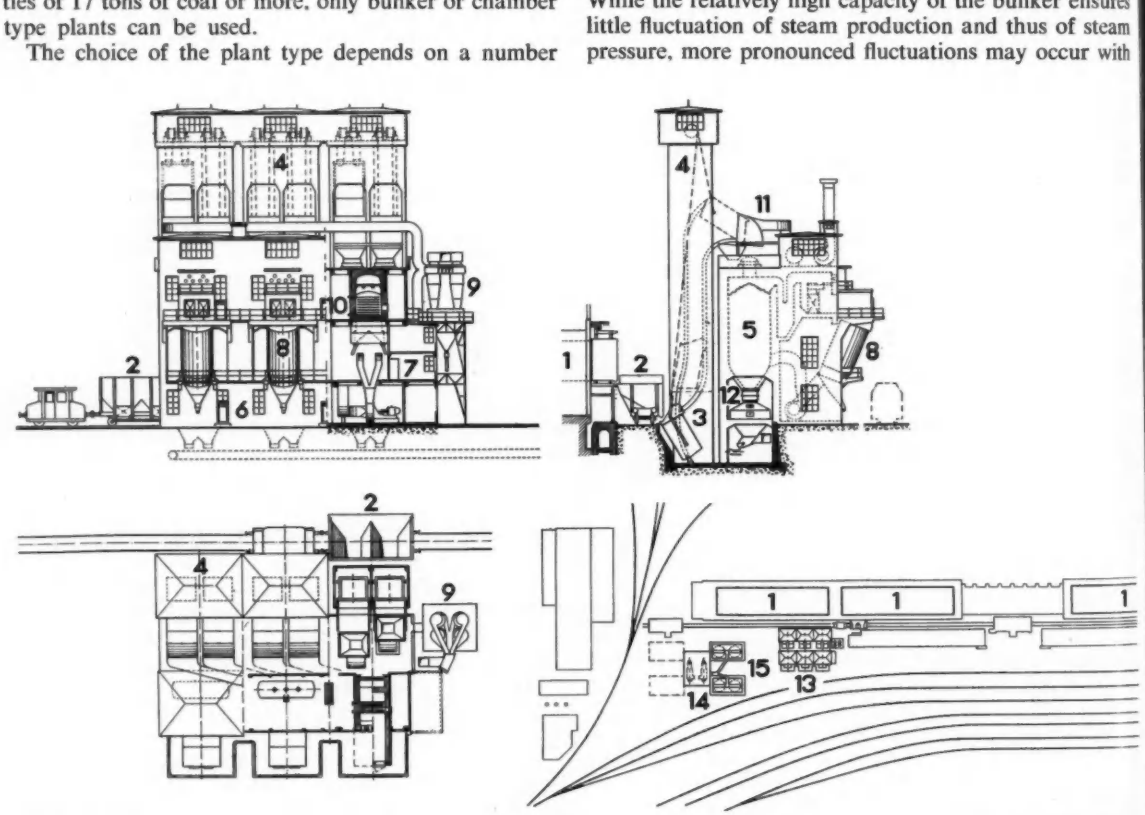


Fig. 3. Coke cooling plant combined with condensing steam turbines. Bunker type, cooling capacity 2,400 tons of coke per day. 1 Battery of ovens, 2 coke car, 3 coke skip, 4 hoist, 5 cooling bunker, 6 fan room, 7 control and equipment room, 8 steam boiler, 9 dust collector, 10 superheater, 11 charging equipment, 12 discharging equipment, 13 coke cooling plant, 14 turbine house, 15 condensers.

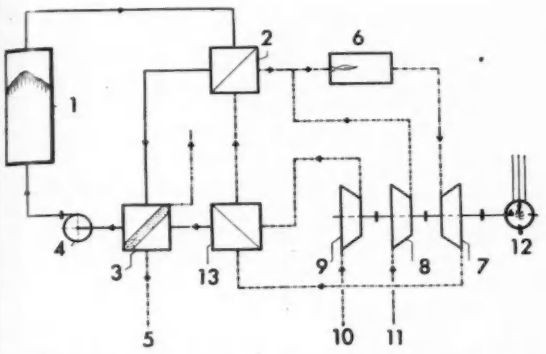


Fig. 4. Coke cooling plant combined with gas turbine with combustion chamber. 1 Coke cooling plant, 2 air heater, 3 steam boiler, 4 cooling-gas fan, 5 exhaust-gas outlet, 6 combustion chamber, 7 gas turbine, 8 gas compressor, 9 air compressor, 10 fresh air, 11 combustion gas, 12 generator, 13 air preheater.

the chamber type. Even with this type, however, the steam production can be kept steady in large plants comprising several units. The single-chamber plant has a disadvantage in that there is a marked peak of steam production when the cooling process commences.

Irregular steam production may have varying effects as far as the steam user is concerned. If the steam is fed into a system operating at the maximum pressure of the coke cooling plant and obtaining most of its steam from direct-fired boilers, the fluctuating production of the coke cooling plant will not be of any practical significance. The fuel-fired boilers will easily be able to smooth out the fluctuations, so that the steam pressure in the mains and in the dry coke cooling plant will be kept approximately constant.

Situation Changed

This situation is changed if the consumer mains operate at a much lower pressure than the dry coke cooling plant. However, if the latter has an adequate storage capacity and gives up the steam through a pressure reducing station, the undesirable effects of irregular production can still be largely suppressed. This is particularly important when the dry coke cooling plant has to cover almost all the steam requirements.

In large and medium-sized works, fluctuations of production and consumption can be effectively dealt with by the provision of a separate steam accumulator. This enables marked consumption peaks to be met and steam surpluses to be stored. Experience shows that steam accumulators—provided that they are rightly attuned to the working conditions—greatly improve plant economy.

In large gasworks producing several hundreds of tons of coke per day, or in the coke works of the steel industry, where the production may attain several thousands of tons, the question arises of how the useful heat contained in the incandescent coke can best be utilised. This question can only be answered after careful study of the power economy of the whole works. The first step is to prepare as accurate a heat and power balance sheet as possible, for it is only on this basis that the optimum link-up of the dry coke cooling plant can be found. If electricity is to be generated, all other sources of waste heat must also be considered, as well as any power obtained from outside.

In recent times dry coke cooling plants have come into use for preheating the combustion air of oven firing systems or the feed water supplied to fuel-fired boilers or even to the coke cooling plant itself. Automatic control stations also permit the combination of two such alternatives, so that the heat can be used at will for either purpose. Where very little of the heat recovered from the coke can be put to direct use, it can be used instead for generating electricity. Up till recently steam turbines were the only machines adopted for this duty, but interesting combinations of dry coke cooling plants with gas or hot-air turbines are now possible.

The diagram in Fig 2 shows a combination of a coke cooling plant and a condensing turbine with steam extraction. The hot gases emerging from the top of the cooling bunker 1 flow first of all through the superheater 2, then through the steam boiler 3 and in a third pass through the preheater 4 for the boiler feed water, after which they return to the coke bunker to be reheated. The superheated steam is expanded and does work in turbine 6, while the steam 7 required for various purposes in the works is bled off from an intermediate stage of the turbine at the desired pressure.

Power and Heat Economy

The question of whether a condensing or a back-pressure turbine should be chosen depends entirely on the power and heat economy of the works. A gross generator output of 2,000 to 3,000 kW per thousand tons of coke and per 24-hour day may be expected, according to the pressures and temperatures employed.

Fig. 3 illustrates a project worked out for a dry coke cooling plant of the bunker type for a capacity of 2,400 tons of coke per 24-hour day. The live steam, at 17 atm. and 350°C. at the superheater outlet, is supplied

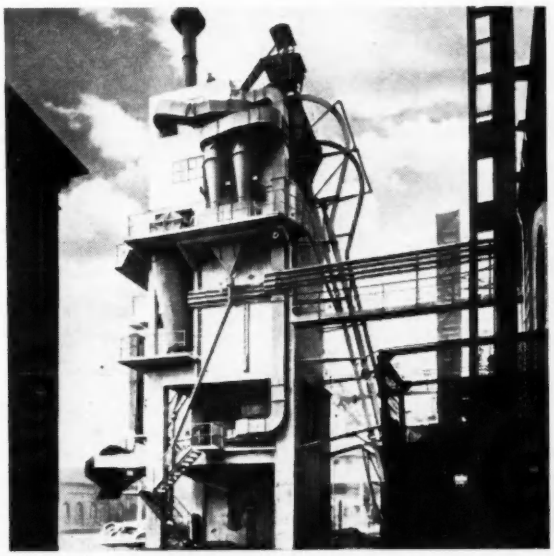


Fig. 5. Sulzer dry coke cooling plant in the Frederiksberg gasworks of the City of Copenhagen. Bunker type cooling 150 tons of coke per day. The waste heat thus recovered is used to raise steam at 15 atm. and 250°C.

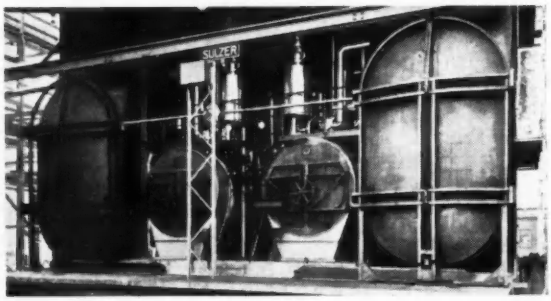


Fig. 6. Helsinki coke cooling plant. Front view of the closed cooling chambers.

to a condensing turbine. No process steam is extracted. The useful output available, after deduction of the power for the auxiliaries of the coke cooling and steam turbine plants, is about 6,900 kW, or 2,900 kW per thousand tons of coke cooled per day.

The next diagram (Fig. 4) shows a combination of a coke cooling and a gas-turbine plant with a combustion chamber. This alternative is of special interest when a gas turbine is in any case installed for power generation, irrespective of the use of coke cooling plant. The heat obtained from the hot coke may here be employed for preheating the combustion air, whether the fuel burnt in the combustion chamber is a gas, a liquid or a pulverised solid. Preheating may also be adopted for the combustion gas, or for both combustion gas and combustion air.

Combinations of this type are extremely favourable from the point of view of power economy. The main reason for this is that a large proportion of the capital is invested in any case in the power generating plant, whereas the combination of coke cooling with combustion air or gas preheating on the turbine side involves comparatively little extra expenditure. The *sine qua non* is that the preheating performance needed for the gas-turbine plant should take up all the available heat from the coke, or at least the proportion not used for producing process steam.

Fig. 5 shows a dry coke cooling plant of the bunker type put into service in 1951 in the Frederiksberg Gasworks of the City of Copenhagen. It cools 150 tons per 24-hour day with skip loads of 3.2 tons. The boiler raises superheated steam of 250°C. at a pressure of 15 atm. Some of this is used in the gasworks, while the rest is supplied to the nearby municipal electricity works. Special attention was here paid to the problem of dust removal. The breeze formed during the charging and discharging of the bunker is collected in centrifugal dust separators from which it is removed at intervals to be used for special purposes. The operation of the whole plant is largely automatic.

A chamber-type plant which was put into service in the autumn of 1954 in the municipal gasworks of Helsinki, Finland, is illustrated in Fig. 6 The two units

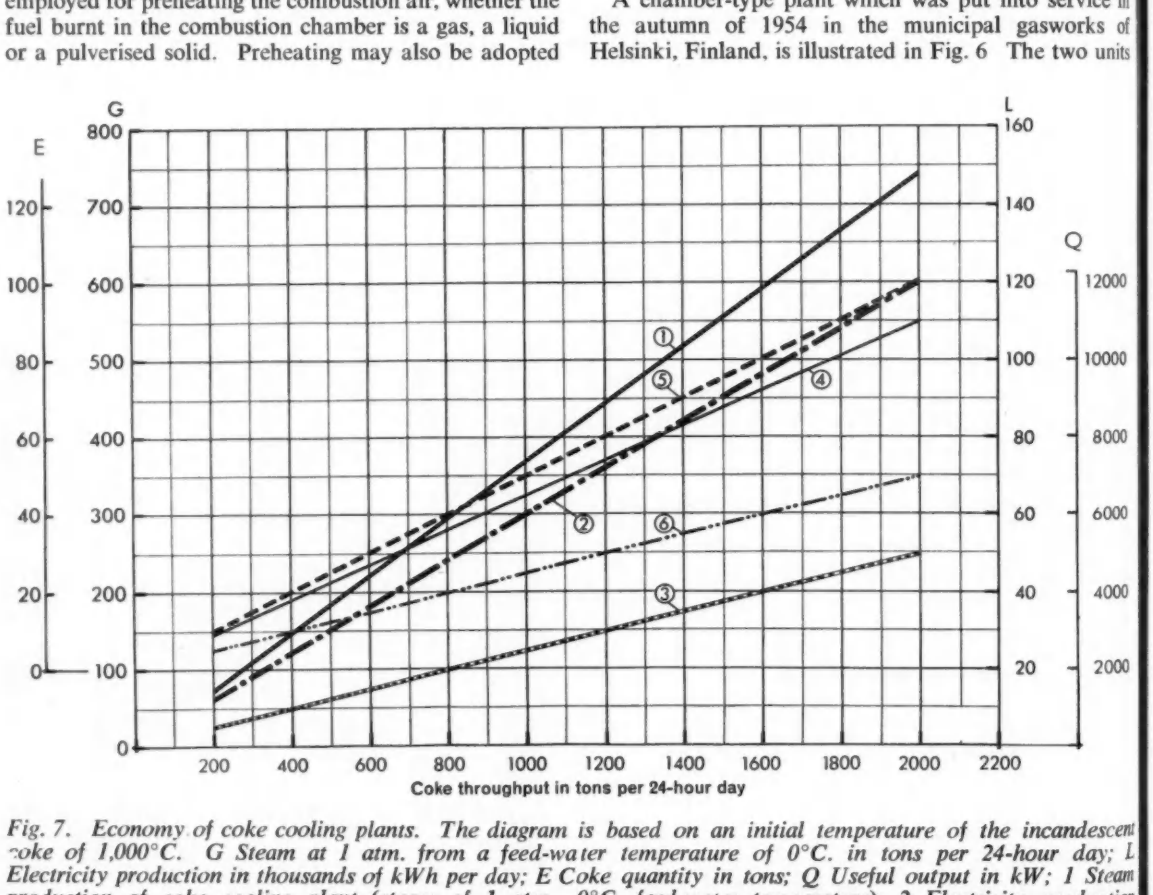


Fig. 7. Economy of coke cooling plants. The diagram is based on an initial temperature of the incandescent coke of 1,000°C. G Steam at 1 atm. from a feed-water temperature of 0°C. in tons per 24-hour day; L Electricity production in thousands of kWh per day; E Coke quantity in tons; Q Useful output in kW; 1 Steam production of coke cooling plant (steam of 1 atm., 0°C. feed-water temperature); 2 Electricity production possible with steam production as under 1; 3 Terminal output resulting from 2; 4 Coke saving in direct-fired steam boilers of a gas or coke works with steam production as under 1 (on assumption of dry-cooled coarse coke or breeze); 5 Saving of blast-furnace coke in tons in blast furnaces and coke works; 6 Saving of high-quality coke in gasworks when burning dry-cooled instead of wet-quenched coke.

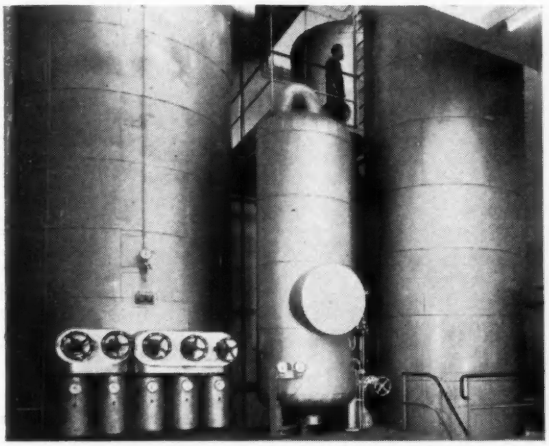


Fig. 8. Heat supply station in the works of Gugelmann & Cie. AG. at Roggwil, Switzerland. Constant-pressure high-temperature water accumulator taking 60 tons of water at 185 lb. per sq. in., with a standby cascade-type heat exchanger and two constant-pressure accumulators of 1,750 cu.ft. capacity each for hot service water.

together cool 240 tons of coke per day. The charge is 8.4 tons, the saturated steam is generated at 13 atm. and goes to a back-pressure turbine. Surplus steam is used in part inside the gasworks, while the rest is supplied to a municipal electricity works.

The factors—apart from steam or electricity generation—which affect the economy of a dry coke cooling plant may be summarised as follows:

Summary

1. Dry-cooled coke, especially if of small size, has a higher calorific value than wet-quenched coke.

2. It is of higher strength and more uniform in size.

3. It is clean and practically free of dust and breeze, less of which consequently remains behind in the user's coke containers.

4. The percentage of breeze is lower in dry-cooled than in wet-quenched coke (whether spraying or dipping is employed). As cooling takes place steadily, the coke does not split. Practical results show that in many works the breeze production is reduced by 25 to 30% as compared with wet quenching.

5. Volatile constituents are more uniformly distributed in dry cooled coke, since incompletely degassed regions are further degassed in the coke cooling plant.

6. The better quality of dry-cooled coke brings substantial savings with it. The fine coke and breeze, being absolutely dry, are good-quality fuels and can therefore be sold at higher prices. Dry-cooled coke (including fines) can be used in water-gas and producer plants, thus making further savings possible.

7. An important factor is the reduction of maintenance expenditure for iron and concrete structures, coke transport and other conveyor plant, as the corrosion caused by the acidulous vapours of wet quenching plant is here eliminated. Similarly no trouble is experienced in winter as a result of ice formation on transport equipment. Finally, the costs of providing quenching water are also saved.

8. The improvements made possible by the use of dry-cooled coke in blast furnaces have resulted in savings of 5 to 7% of the coke throughput in plants now in practical service.

9. Dry coke breeze under 2 mm. in size can be used in the coal distilling process; the utilisation of this breeze (in quantities up to 2% of the coal throughput) is equivalent to a gain of the same amount of coarse, high-quality coke. It may be added that good results have also been reported with dry coke breeze in the sintering of ores. In a certain case the time required for reaching the sintering temperature was reduced from 60-65 to 17 minutes, representing a reduction of about 70%.

When a project is prepared for a coke cooling plant, an economy estimate based on the actual conditions should be worked out. Dry coke cooling plants can generally be amortised in a comparatively short time. Fig. 7 furnishes information on steam production, the possible generation of electricity, coke savings in gasworks and blast furnaces as a function of the cooling capacity per day.

If the dry cooling system were universally adopted, enormous amounts of fuel could be recovered and put to other uses, while a great deal of transport could be saved. Where a million tons of coke is produced, dry cooling will permit the saving of 45,000 to 55,000 tons now burnt in direct-fired boilers. For the transport of this quantity of coke, 4,500 to 5,500 ten-ton railway trucks are required. It may be mentioned that the total coke production in England in 1947 was about 29 million tons the Swiss production in the same year amounted to 320,000 tons.

These figures show quite clearly that the Sulzer dry coke cooling system is not only of interest to the private undertaking but, applied on a wide scale, would noticeably affect the national economy.

Description of plant and processes, as well as illustrations and diagrams, are reproduced by courtesy of Sulzer Bros. (London) Ltd., and appeared originally in the *Sulzer Technical Review*, vol. 39/1957, No. 4.

Use of the Kite-mark

NEARLY 1,500 manufacturers licensed to use the B.S.I.'s 'Kite-mark' on their products are included in two British Standards Institution lists. Industrial goods and consumer goods are separated into List 'A,' and List 'B' respectively. The 118 standards listed in the former affect a wide range of goods supplied by one section of industry to others; they include building and electrical materials and components, personal safety equipment, various cycle and automobile accessories and materials such as fillings for bedding and upholstery, where cleanliness is important. A useful index is also included.

In List 'B' on consumer goods, more than 200 firms are listed as licensees under B.S. 1960, whose five parts prescribe rigorous performance tests to establish the durability of all types of domestic furniture; while some 150 manufacturers are licensed under B.S.1877 for domestic bedding. Some of the other consumer goods in this list of 27 standards where the 'Kite-mark' operates are plastic w.c. seats and covers, pressure cookers and motor-cyclists' crash helmets.

Copies of both lists, which have been prepared mainly to help buyers who want to know on what goods they can find the assurance of the 'Kite-mark,' may be obtained from British Standards Institution, Sales Branch, 2, Park Street, London, W.1, price 2s. each.

Stud Welding Has Many Applications in the Gas Industry

writes JOHN GRINDROD

BASICALLY the principle involved in stud welding is the fixing of a variety of different studs or attachments to metallic structures and components. Other methods, which may be considerably more expensive in terms of man hours and sometimes impossible, are drilling and tapping, riveting, arc welding, and resistance welding.

Comparative costs on one isolated job involving the application of 58 studs to a transformer were—(a) by drilling and tapping (including labour, materials, and overheads), £2 7s. 9d.; (b) by fixing 58 studs by stud welding (again including labour, materials, and overheads, £1 0s. 6d.

Since these figures were obtained the differential between labour costs and material costs has widened further—and seems likely to increase—so that stud welding, being a semi-automatic process necessitating only semi-skilled labour is rapidly replacing studding by drilling and tapping in a variety of industries.

Two Types of Equipment

With the stud welding process, studs from as small a diameter as $\frac{1}{16}$ in. to a maximum diameter of 1 in. may be fixed by two different portable types of equipment, the stud welding tool being operated in any direction from vertically upwards to vertically downwards. Studs of brass or steel may be welded to steel whilst recent developments have enabled the equipment to be used to weld pure or aluminium magnesium alloy studs to pure or the range of non-heat treatable alloys of aluminium.

In the gas industry there are many obvious applications. A number of holders are now manufactured by stud welding with a considerable saving in time and labour. Particularly in the repair of gas holders without putting the holder out of commission, it is possible to stud weld on to the original holder and then oversheet with new material.

The basic equipment for stud welding consists of the stud welding tool usually portable but supplied for machine or bench mounting. At the beginning of the welding cycle, the stud or attachment is placed in the tool by the operator and the welding tool held against the plate or structure.

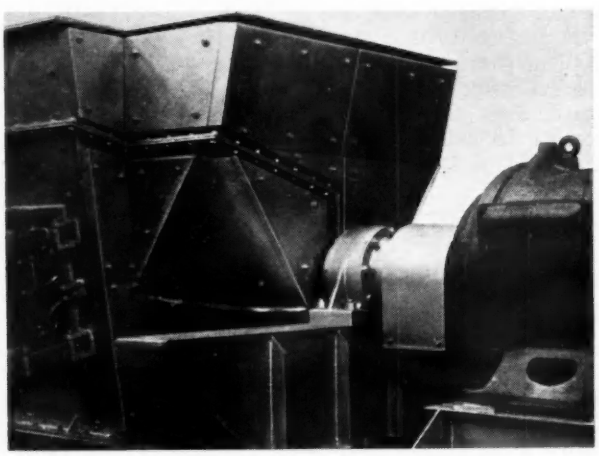
As soon as the welding current flows an arc is drawn, usually by lifting the stud away from the parent structure which is accomplished by the pull exerted on a moving armature by a solenoid inside the body of the tool and to which is attached a chuck or collet holding the stud. Sometimes the arc is initiated by fusing a small pip on the end of the stud to create an arc gap, there being no provision in this case within the tool for lifting.

Operator using stud welding tool.

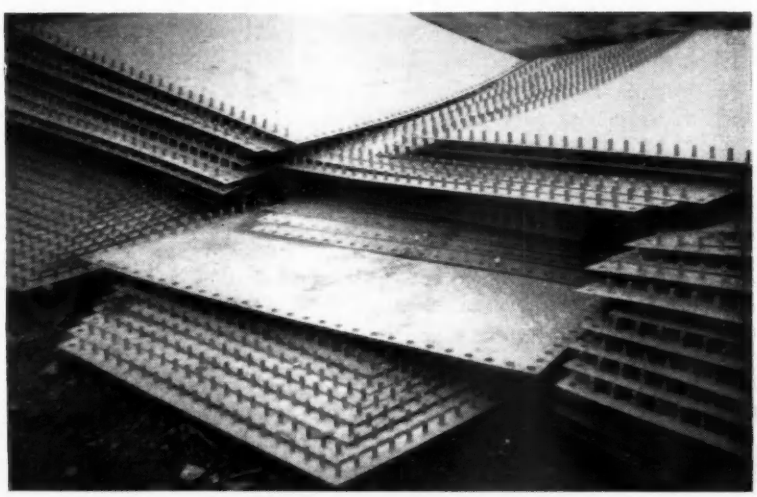
The tool ensures that the stud or attachment is at the correct angle relative to the surface and is provided with quickly detachable and interchangeable chucks or collets to hold and pass welding current to studs and attachments of different shapes and dimensions.

The other part of the equipment is a control unit the function of which is the automatic make and break of the welding current and to time and control accurately, the sequence of operations during the welding cycle.

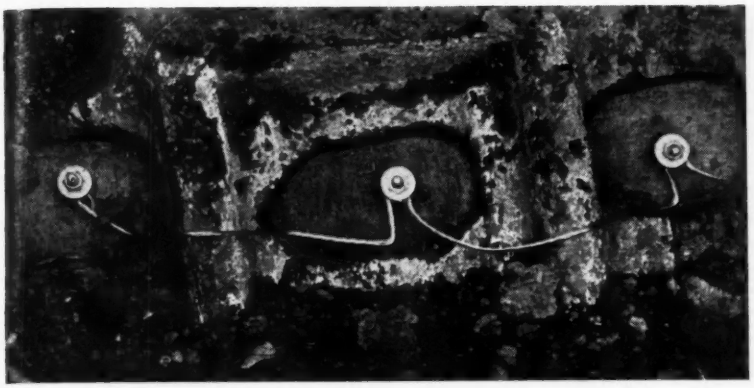
The welding flux goes in or on the end of the stud, but a ceramic or refractory ferrule is used to shield the molten metal during a weld. The ferrules have small radial vents through which the slag and other impurities are blown clear by



Pictured left is a notable example of the use of stud welding in coal and coke crushing plant.



Stud welded plates for gasholder at the Sheringham works of the Eastern Gas Board.



Stud welding used for cathodic protection contact on underground pipe.

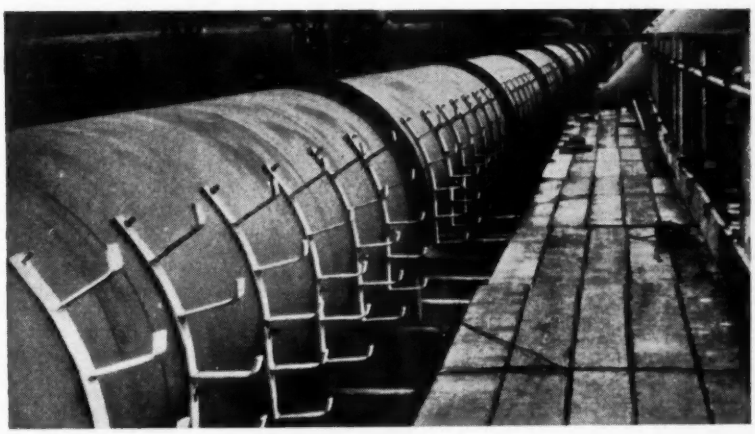
the vapour pressure developed at the temperature of the arc.

There is a choice of equipment. The Nelson 'H' type will weld ferrous studs from $\frac{1}{16}$ in. to $\frac{3}{4}$ in. diameter to sufficiently robust standards to be used on open site work. The Cyc-arc equipment will weld both ferrous and non-ferrous studs (up to 1 in. diameter or even above) and is particularly valuable when precise accurate location is required. The Cromp-arc 'J/K' type will do all the work done by the above-mentioned Cyc-arc equipment using studs from $\frac{1}{16}$ in. to $\frac{3}{8}$ in. diameter. It is a very light equipment easily handled by female labour.

To the user of such equipment much depends upon the service offered and Crompton Parkinson (Stud Welding), Ltd., operate sales and service units on demand or under a service agreement scheme from Birmingham, Cardiff, Glasgow, London, Manchester and Newcastle. Since the applications of stud welding are ever increasing, a demonstration van with equipment will give demonstrations free of charge in any part of the United Kingdom.

In addition, there is always the specialised application—a case where stud welding might or might not appear to be a satisfactory solution and in this respect the engineering development department of the Company is available to offer advice in the light of the continuous research and development experience of stud welding which it has acquired.

Invariably, and particularly in the case of structural steelwork, wherever there are numerous operations of studding by drilling and tapping the changeover to stud welding has both speeded up the operation and reduced the labour, material and overhead costs, quite considerably.



Brackets in process of being stud welded to overhead coke oven gas main. It was not necessary for the gas to be cut off during the operation.

Vital Role of Natural Gas in U.S.S.R. Chemical Industry

A HEAVY strain has been placed on Russia's natural gas industry by a recent decision to boost the development of the Soviet chemical industry. To meet the requirements of this plan, research teams are working on developing new methods for the chemical processing of natural gas, and it is intended to build several new gas and benzine plants.

Big Expansion Planned

The annual output of liquid gas in the Soviet Union is now 60,000 tons, but by 1965 a target of 4 mill. tons had been set. Tremendous possibilities for the production of so-called gas condensates—a raw material used in chemical production—are said to exist in the Ukraine and other areas.

A rapid expansion is envisaged for the whole gas industry. By 1972, it is anticipated that Russian will be producing about 9.45 bill. cu.ft. of gas annually. Something like 15,725 miles of trunk pipelines will be constructed to carry gas to the most important economic regions of the country.

Less Dutch Coal

THE report for 1957 of the Netherlands State Mines says that coal production was lower than expected, due to a shortage in underground labour and the reduction in working hours. But the drop in output, causing a corresponding increase in costs, was compensated by favourable results of the coke and chemical factories.

Institute of Welding

The 1958 annual assembly of the International Institute of Welding took place recently in Vienna. The opening session was attended by Dr. Adolf Schärf, President of the Austrian Republic, who addressed the delegates.

VAST SOURCE OF METHANE IN BELGIAN CONGO

A TREMENDOUS source of power for the Belgian Congo appears to be contained in the bed of Lake Kivu. The presence of gas there was reported by Professor Damas, of Liège, in 1937, but the type of gas was not established. But ten years ago, Cappart and Kufferath found, during a scientific expedition, that it was methane.

Doubt Removed

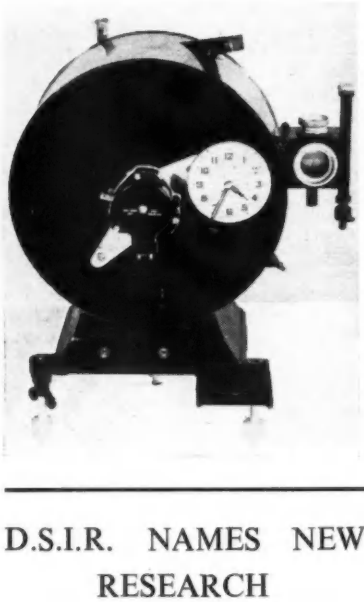
The Union Chimique Belge, at the request of the Belgian Colonial Ministry, has now gone thoroughly into the matter of gas strata in Lake Kivu, and has established without doubt that the discovered layers contain about 200 mill. cu. m. of earth gas, of which 25% is methane.

It has already been suggested that the heavy industry of the Congo, even if situated hundreds of miles from Goma, could easily be supplied with this gas.

New Calorimeter Meter Control Developed at N.T.G.B. Brentford Laboratories

A PATENT application has been filed by the North Thames Gas Board for an improvement in fluid metering apparatus, which has a particular use with gas calorimeters.

When using a wet meter at a controlled rate, as in the Fairweather calorimeter it is usual to employ an electromagnetic escapement. Although this has been improved in recent years by means of the articulated type of escapement, the method has the disadvantage that the scape wheel and pallets wear, and need to be accurately adjusted. Probably 90% of recorder failures are due to escapement troubles



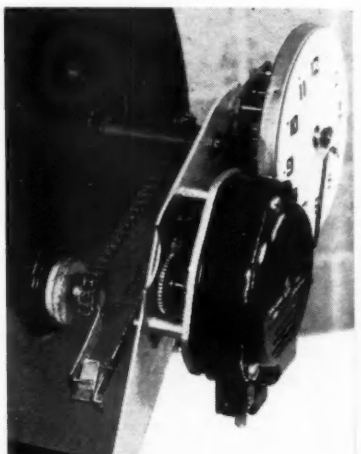
The new invention, developed at the Board's Brentford laboratories by R. F. Carter and P. Stripp, utilises a synchronous electric motor running at constant speed, to control the rate of rotation of the meter. The motor is coupled to the meter by a 'one way' drive, so that the meter which is being driven by the gas pressure, is held back by the motor to the correct rate.

In the event of gas supply failure or cut off, the motor is free to rotate, without driving the meter, but the gas meter cannot drive or overtake the electric motor. The illustrations show the general arrangement.

A clock dial is attached to the unit for checking purposes. The clock mechanism is driven by a light chain or other suitable means, from the meter spindle, and shows the actual rotation of the meter, which is of course normally the same as that of the motor. Any lag of the meter due to drop in gas pressure, etc., would result in the clock losing compared with correct time.

An advantage of this method is the more uniform rotation of the meter. Irregularities due to the buffer spring and the seconds impulse operation of the escapement type are eliminated, and in practice a much smoother gas flow and steadier water line are obtained, leading to greater accuracy in measurement.

The synchronous motor (230 volt 50 cycles) is of the type commonly used in recording instruments, and these usually give years of service without maintenance.



To cover the slight possibility of power failure, a relay can be arranged to switch over automatically to a supply from a Valradio vibrator convertor, working off a 6-Volt battery. This can be adjusted very accurately to less than 0.1% of the correct frequency.

D.S.I.R. NAMES NEW RESEARCH CONTROL BODIES

THE Council for Scientific and Industrial Research are making a change in organisation affecting two D.S.I.R. laboratories. Small steering committees are being set up to bear responsibility for the research programmes at the new Warren Spring Laboratory, at Stevenage, and at the recently renamed National Chemical Laboratory, at Teddington.

Steering Committee

The Warren Spring Laboratory Steering Committee comprises—Chairman, Sir Harry Jephcott; Members, Dr. R. Holroyd, Mr. D. A. Oliver, the Secretary of the D.S.I.R., and the Director of the Warren Spring Laboratory. The National Chemical Laboratory Steering Committee, which will assume responsibility from October 1, will be—Chairman, Professor C. E. H. Bawn, Members, Dr. F. Roffey, Mr. B. Topley, the Secretary of the D.S.I.R., and the Director of the National Chemical Laboratory.

INTERESTING PRACTICAL HELPFUL

VISITORS to Hulton's Boys' and Girls' Exhibition now open at London's Olympia, will find the Gas Council stand interesting, practical, helpful. Interesting because it shows by working models and photographic displays how a modern industry is meeting modern demands; practical because it lists some of the careers available in the gas industry; helpful because it shows how exciting dishes can be cooked by gas.

The stand is divided into two parts. Half of it is based on the colour strip, 'What's Cooking with Carol and Chris' which appears regularly in *Girl*, one of the Hulton publications. The other, 'Live and Learn with Mr. Therm,' provides a link-up with the feature of this name which appears in *Eagle*.

There will also be panels outlining a few of the many careers offered by the gas industry to both boys and girls. The careers range from accountancy to engineering; from chemical research to personnel management.

COURSES ON GAS AT EAST HAM TECHNICAL COLLEGE

DETAILS of courses on gas fitting, manufacture, supply, and salesmanship are given in the prospectus for the 1958-9 session of East Ham Technical College.

The college is well provided with equipment suitable for the practical work required of students attending these courses which are arranged to enable students to sit for the appropriate examinations of the City and Guilds of London Institute and the Institution of Gas Engineers.

Approved Centre

The college is an approved centre for instruction, and a special laboratory is available for this work, which includes photometric measurements, the use of gas measuring instruments, the testing of illuminating gas, comparative tests with gas-fired hot water installations of various types, radiant heat measurements and gas examiners' tests.

UNITED GAS INDUSTRIES LTD.

Chairman Speaks of Unsettled and Exacting Year at Annual Meeting

IN his statement accompanying the annual report of United Gas Industries Ltd., for the year ended March 31, 1958, Mr. Norman L. Smith, Chairman, said the year had been more unsettled and even more exacting than anticipated. There had been severe falls in the prices of primary products and several countries had found it necessary to re-impose exchange control regulations.

Not Fully Felt

In the previous year they had felt only partially the impression of the 1956 wage award; the present accounts reflected the full effects of that award as well as the 1957 award.

These factors, coupled with the reduction in demand which followed the Government's policy in regard to the nationalised industries, had combined to decrease the profit margin on meter sales—still a most important item of their production.

Active Steps

The Directors were continuing to take active steps to meet changing conditions. They had set up two separate manufacturing divisions, bringing together the whole resources of the Group into parallel organisations both directly responsible to the parent Board, and there were already signs of substantial economies in overhead expenses resulting from this policy. They had also concentrated manufacture of certain products in the larger factories and had closed the smaller ones which had become uneconomic.

Group trading profit for the year, the accounts show, amounted to £472,392 (1957 £472,251). After exceptional items but before taxation the Group profit is £309,127 (1957 £314,937) and, after taxation, £109,241 (1957 £127,516).

Profit retained by subsidiary companies amounts to £13,932, and the amount brought into the accounts of the holding company is £108,323. To this is added the unappropriated balance from the previous year, £150,360, and after charging taxation adjustments in respect of earlier years of £5,579, the balance available for appropriation is £253,104.

During the year net dividends were paid on the Preference shares totalling £25,703 and an Ordinary interim dividend at the rate of 3¼% (less tax) absorbed £16,790.

Final dividend on the ordinary shares of 8¼% (less tax) is recommended, bringing total distribution to 12½% for the year (compared with 14% for the previous year.) Dividend on the Deferred shares will be 8½d. per share (less tax.)

No allocation has been made to general reserve, and the unappropriated balance carried forward is increased by £9,955.

W.M.G.B. PROPOSES NEW SITE FOR COLESHILL PLANT

PLANS for an alternative site for a proposed £4.5 mill. gasification plant at Coleshill have been submitted to Meriden Rural Council by the West Midlands Gas Board. The site is between that proposed at Forge Mills and Hams Hall Power Station.

Not Yet Announced

Building of the plant at Forge Mills was refused by Warwickshire County Council last year and in October a Ministry enquiry was held at Water Orton. The Minister has not yet announced his decision on the Gas Board's appeal.

A spokesman of Meriden Rural Council said on Thursday that the new plan was received only a few days ago and was being considered by the council's Plans and Town Planning Committee.

WORLD'S BIGGEST LIQUID GAS SHIP

CLAIMED to be the world's largest ship to be built specially for the transport of liquid gas, a new tanker is to be constructed by Bijkers Contractors, Ltd., at Gorinchem, Holland, for the Marine Caribbean Lines shipping company of New York.

To transport liquid propane and butane gas, this tanker will be equipped with 19 pressure tanks with a total capacity of 3,180 cu. m. Her length will be about 100 m., beam 14.15 m., and draught 7.50 m. She is expected to be ready in about three years.

Falk, Stadelmann & Co.

Among members of the London and branch offices of Falk, Stadelmann & Co., Ltd., 134 have been with the Company for 30 years or more. This does not include works. Of these, nine have had more than 50 years', 29 more than 40 years', and 96 more than 30 years' service with the firm.

British Oxygen Co. Ltd.

Interim dividend on £17,047,166 Ordinary stock of 4%, less tax at 8s. 6d. in the £, on account of the year ending September 30, 1958, has been declared by the British Oxygen Co., Ltd.

POWELL DUFFRYN ANNOUNCE TRADING RESULTS

CONSOLIDATED trading profits of Powell Duffryn Ltd., including income from investments and interest receivable, for the year ended March 31, 1958, after deducting interest on debenture stock, Directors' remuneration, and profits attributable to outside shareholders, amount to £2,032,709 (previous year £2,199,237, to which was added £15,594 being the final amount accrued in respect of interim income under the Coal Industry Nationalisation Act.

Net Profit

Depreciation charged before arriving at the above figures was £844,181 (£753,672). After taking credit for £221,000 (1957, £95,000) of relief arising from investment allowances on capital expenditure, taxation requires £969,046 (£1,176,398), leaving consolidated net profit for the year at £1,063,663 (£1,038,433), to which has been added a transfer from taxation reserves of £150,000 (£178,000), bringing the total consolidated net profit up to £1,213,663 (£1,216,433).

Dividends

Payment is recommended of final dividend on Ordinary shares of 10% actual, less tax at 8s. 6d. in the £, on the 9,660,471 Ordinary shares of 10s. each in respect of the year ended March 31 (making, with the interim dividend of 6%, actual, paid on February 25, 16% for the year).

The amount at the credit of the consolidated profit and loss appropriation account to be carried forward to 1958-59 is £2,791,819 (£2,522,959).

The annual general meeting will be held on September 17.

Beckman Instruments

A talk and demonstration were recently given by Mr. K. G. Solla, of Beckman Instruments, Munich, on the Beckman Model GC-2 gas chromatograph at the London showrooms of Baird & Tatlock (London) Ltd., agents in the United Kingdom for Beckman Instruments, Inc. This instrument is very versatile and can handle gases and liquids with boiling points up to 350°C. The reproducibility is ±0.1%.

New Depot Opened

DONALD MACPHERSON & CO., LTD., makers of Foochow decorating and industrial finishes, have opened a service centre and depôt at Maguire Street, off Vauxhall Road, Liverpool 3. Mr. D. W. Jones and Mr. N. M. Roberts, will be working in close conjunction with this service centre, where a complete range of decorative finishes will be stock. Mr. J. E. Faulkner is depôt Manager.

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Town's gas-fired Twenty Strand Wire Annealing Furnace for bright annealing high nickel wire of all gauges

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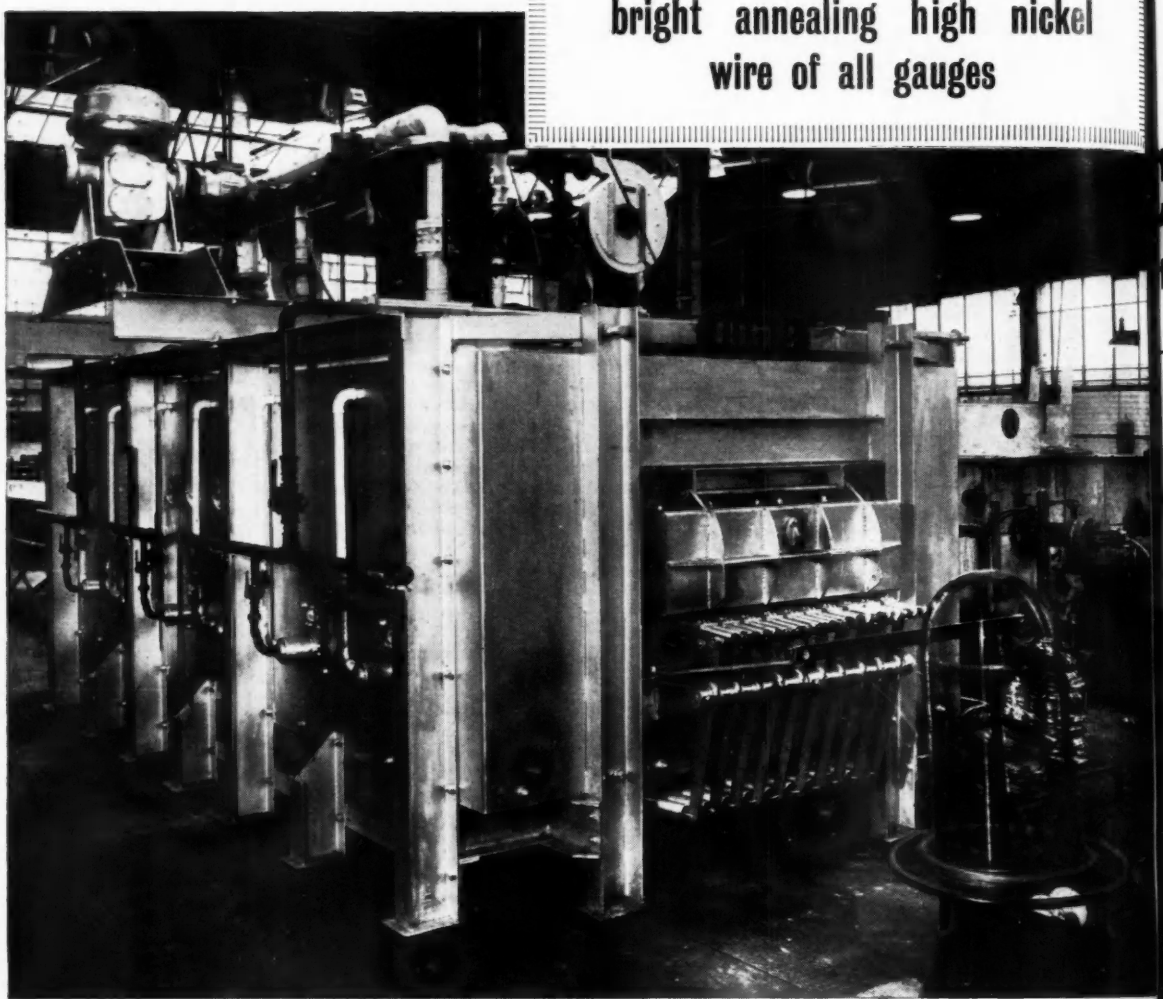

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